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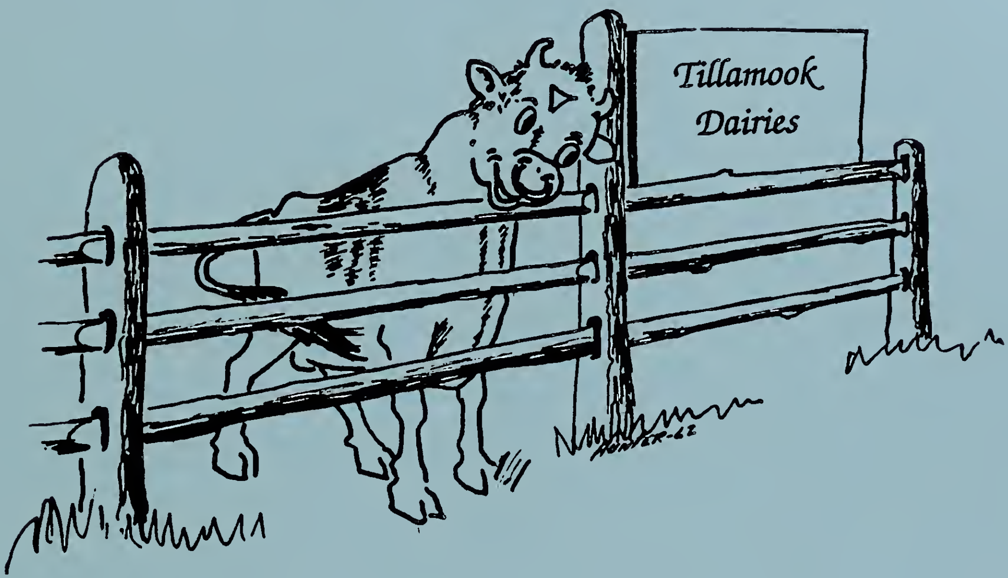
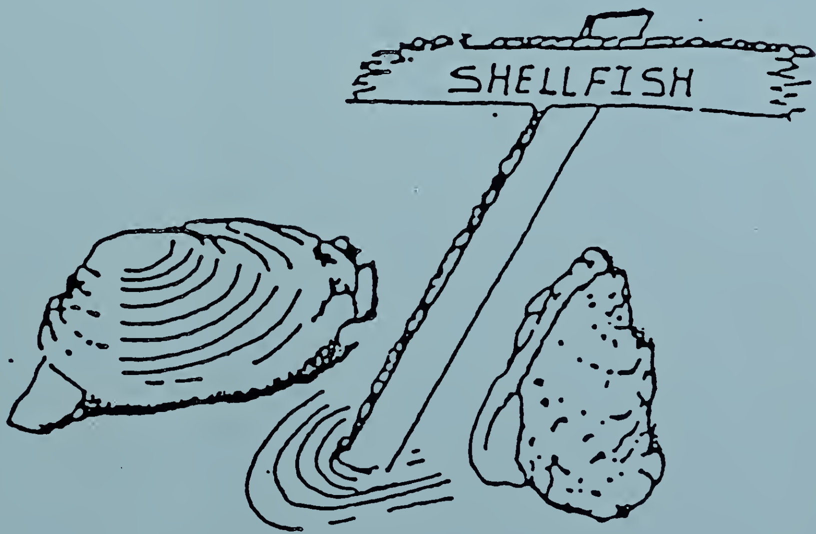
University

Tillamook Rural Clean Water Project

10-year Progress Report
Tillamook County, Oregon





United States
Department of
Agriculture

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Tillamook County, Oregon

September 1991

Acknowledgments

This project report represents a tremendous effort from a large number of people. Members of local and technical advisory groups, and individuals from numerous agencies, all spent many hours and made signifiant contributions.

The risk of omitting someone prevents the development of a complete list of those deserving acknowledgement. To those many—a huge thank you for a job well done!

This project has made a tremendous difference and the total impact has not yet been realized.

For More Information:

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1.0 Project Findings and Recommendations

Findings

- It is too early to make a final assessment of RCWP results. Water quality improvements are expected to occur for a number of years after all BMP's are installed and contracts completed. These changes will occur as operators develop management techniques to utilize implemented and installed BMP's.
- Partial success of the Tillamook project is due to the agricultural industry's strong involvement.
- Cooperation between federal, state and local agencies and organization was outstanding.
- National RCWP application guidelines were not well defined when program was announced.
- The Tillamook Project required extensive agency time commitments.
- Project's publicity while very beneficial, will increase agency time requirements.
- In the Tillamook Project, a computer was effective in planning, implementing, administrating, tracking and developing workload analysis.
- An initial inventory of needed BMPs for all critical farm operations is helpful.
- Farm visits are required to identify critical operations. Visits should be conducted during wet weather.
- The Tillamook Project used a rating system to identify potential critical agricultural operations. This system was helpful in prioritizing RCWP applications and treating critical areas.
- Tours for financial lending institution representatives are useful in assisting participants to obtain their portion of the BMP expenses.
- Localized crop nutrient uptake data is needed to develop local manure utilization specifications.
- According to participants, the Tillamook RCWP has reduced commercial fertilizer usage.
- Manure nutrients saved and utilized will offset and utilized manure management system implementation costs.
- Traditional BMPs may not be adequate to solve manure runoff problems.
- A BMP component system is more effective in solving agricultural related pollution problems than a single BMP.
- BMP components must be considered when developing realistic BMP average costs.

- In a high rainfall area, managing and/or diverting rainwater away from animal manure accumulation or storage areas is an important consideration in BMP planning and implementation.

- Roofing manure accumulation areas in a high annual rainfall area is more cost effective than collecting and storing contaminated rainwater.

- The influence of BMPs on water quality is still inconclusive even though water quality improvements have likely occurred in Tillamook Bay.

- A minimum set of parameters for which monitoring is needed include: fecal coliform bacteria, bay salinity, river flow and rainfall.

- Bacteria data is highly variable and not normally distributed.

- Data conversion difficulties hampered efforts to respecify BMP variables into a single practice variable, which would correct the multicolinearity problems.

- Missing variables such as river levels and flood stage information play an important role in specifying fecal coliform levels that may influence the role of BMPs.

- Contract violations are likely to occur. Strong local leadership (peer pressure) is a key element in correcting problems and having a successful project.

Recommendations

- Program announcements should contain clear project application guidelines and allow sufficient time for submission of complete applications.

- Considerable hours were required to write the RCWP Ten Year Report due to the format not being established at the project's onset. Reporting format shoud be developed during project's beginning. Required data can be developed, collected and evaluated as the project is implemented.

- At the national level, a procedure for transferring project funds to cooperating agencies is needed. This will assure efficient program administration at the state level.

- For future projects, agencies responsible for administration, planning, implementation and collecting and analyzing water quality data, should have computer networking capabilities.

- Adequate technical staff must be available.

- For future projects requiring a large planning workload, consideration should be given to permitting annual status reviews for 10-year contracts to start three years following the plan development except where substantial contract completion has occurred.

- Local decision makers must have the flexibility in choosing BMPs for cost-share assistance.

- Future projects should encourage the use of the Agricultural Conservation Program (ACP) or other state and local program funding sources in conjunction with project funds.

- BMPs must be developed at the local level. The agricultural industry and potential participants must be involved in the BMP identification process.

- A low interest loan program is needed to assist participants with their portion of the BMP costs. This would accelerate BMP installations, decrease program length and provide earlier water quality improvement trends.

- In order to be successful, the monitoring effort must receive adequate and stable funding and staffing throughout the life of the project.

- Sufficient baseline water quality conditions are needed prior to project implementation.

- A minimum monitoring strategy should be established early in project planning and should then be adhered to throughout the project.

- Monitoring strategy should include regularly spaced sampling on a predetermined schedule, at least at a sub-set of indicator sites (i.e. monthly or even more frequent sampling).

- Methods of data analysis should be decided on early in project planning in order to ensure that data sufficient for the anticipated analysis is collected.

- Regular monthly sampling should continue to allow a more complete evaluation of the project at a later date (improvements resulting from installation of manure management practices would be expected to continue for some period of time).

- Additional intensive monitoring studies, particularly during summer/fall runoff episodes, would be useful both for evaluating installed practices and for identifying "hot spots" that need further work.

2.0 Introduction/Project Background

2.1 Overview of the Rural Clean Water Program

The Rural Clean Water Program (RCWP) is a federally-sponsored program designed to control agricultural nonpoint source (NPS) pollution in rural watersheds with the goal of improving water quality. Initiated in 1980, the RCWP was established as a 10 to 15 year experiment offering cost-sharing and technical assistance as incentives for voluntary implementation of Best Management Practices (BMPs). The objectives of the RCWP are to:

- Achieve improved water quality in the approved project area in the most cost-effective manner possible in keeping with the provision of adequate supplies of food, fiber, and a quality environment;

- Assist agricultural land owners and operators to reduce agricultural NPS water pollutants and to improve water quality standards or water quality in rural areas to meet water quality standards or water quality goals; and

- Develop and test programs, policies, and procedures for the control of agricultural NPS pollution.

With a total appropriation of $64 million, the RCWP has funded 21 watershed projects across the country. These projects represent a wide range of pollution problems and impaired water uses. The RCWP projects were selected from state lists of priority watersheds developed during the Section 208 planning process under the 1972 Clean Water Act. Projects are located in Alabama, Delaware, Florida, Idaho, Illinois, Iowa, Kansas, Louisiana, Maryland, Massachusetts, Michigan, Minnesota, Nebraska, Oregon, Pennsylvania, South Dakota, Tennessee/Kentucky, Utah, Vermont, Virginia, and Wisconsin. While water quality monitoring has been performed in all 21 projects, five of the RCWP projects (Idaho, Illinois, Pennsylvania, South Dakota, and Vermont) were selected to receive additional funding for comprehensive monitoring and evaluation.

Each project involves both land treatment and water quality monitoring. Landowners were contracted to implement BMPs, with the length of the contract depending on the practice being implemented — typically three years minimum (e.g., conservation tillage) and ten years maximum (e.g., terraces, animal waste management systems). Most RCWP project contracts began in 1980-81 and ended in 1986, with project results currently being evaluated. The RCWP program will terminate in 1992; however, a few individual projects have been extended until 1995.

The RCWP is administered by the USDA's Agricultural Stabilization and Conservation Service, and is based on the principle of interagency cooperation and the existing federal/state/local partnership. The RCWP is also assisted by other federal agencies, including the Soil Conservation Service, Environmental Protection Agency, Extension Service, Forest Service, Agricultural Research Service, Economic Research Service, and Farmers Home Administration, as well as many state and local agencies.

Both direct water quality benefits and a wealth of experience in agricultural NPS pollution control have resulted from the RCWP. Results and lessons learned from RCWP projects constitute an important source of information for other federal and state NPS pollution control programs. The program has also helped to define research needs and has increased public awareness of this important water quality problem.

The following report constitutes a 10-year report on one of the 21 RCWP watershed projects. Each 10-year report describes the watershed project undertaken, monitoring conducted, results as of 1991, and recommendations.

These 10-year reports, other project data, and on-site project evaluations will provide the basis for a final summary and evaluation of the entire RCWP to be prepared by the National Water Quality Evaluation Project (NWQEP) by the end of 1992. Finally, some of the projects that have been extended past 1991 may also publish addendum reports.

2.2 Project Background

2.2.1 Water Quality Problems and Impaired Water Uses

Before the project was started, there were severe in-stream water quality problems. Major Forest Fires, such as the Tillamook Burn, caused severe erosion. Streambank erosion had occured along the five rivers that flow into Tillamook Bay. The seafood and commercial fishery industries had suffered as a result of sediment accumulation in Tillamook Bay. Sediment had smothered eelgrass, shellfish beds, shellfish larvae and severely affected recreational boating.

A potential human health hazard existed due to the high fecal coliform levels in the river systems and Tillamook Bay. The primary source of fecal coliform was overloaded sewage treatment plants, failing septic tanks and manure runoff from dairy operations. Shellfish harvesting had been closed down unexpectedly during periods of high fecal contamination and health hazards existed in the tributaries where water contact activities are very popular.

Livestock operations produced 322,500 tons of manure annually. The combination of this "never ending" volume of manure, lack of manure handling and storage facilities and the predominantly wet climate created runoff and contamination conditions not equaled anywhere else in Oregon.

Affected along with the commercial oyster industry was recreational clam digging, fishing, boating, and numerous other activities attracting more than a million tourists and sportsmen to the area each year. The result was a serious human health hazard.

2.2.2 Overview of Project

The Oregon State RCWP Coordinating Committee (SCC) rated the Tillamook Bay Project as a high priority. It dealt with the number one agricultural nonpoint source water quality problem in Oregon: Contamination of waters in the Tillamook Bay Drainage Basin.

This project was recommended by the SCC because of the following factors:

- A study of the basin's dairy farms resulted in the critical area identification.
- Some Best Management Practice (BMP) solutions were available and had been tested in the basin.
- With the exception of overloaded sewage treatment plants and failing septic tanks the watershed was relatively free from other outside pollution sources. This made the project very suitable for evaluating RCWP impacts on reducing agricultural related pollution.

2.2.3 Physical Setting, Climate, Population

Physical Setting: The Tillamook Bay Drainage Basin is located in Tillamook County in northwestern Oregon. It is bounded on the east by the Coast Mountain Range and on the west by the Pacific Ocean. The elevations in the area range from sea level to 3,461 feet.

The basin consists of five watersheds totaling 363,520 acres. Tillamook Bay at high tide is six miles long and at some points, three miles wide, covering approximatly 12 square miles. The farmland is located primarily in the lowlands adjacent to the bay and the five rivers. Approximately 65 miles of rivers and tributaries wind through the project area. Many miles of man-made ditches also exist. Soils in the basin range from well drained, fine-textured soils in the uplands to very poorly drained, extremely acid soils in the tidelands.

Climate: The area has a marine climate due to proximity of the Pacific Ocean. Generally, temperatures do not exceed 90 degrees Fahrenheit more than one or two days per year. Temperatures of 10 degrees or lower are rare with the average annual temperature being 50 degrees Fahrenheit.

Eighty-four percent of the annual precipitation (90 to 150 inches of rain) falls between October and May. This produces 2,628,296 acre feet of average annual water yield which flushes down five major river systems into Tillamook Bay's estuary. Annual flooding is common in the lowlands. Flooding generally occurs between December and February.

This Oregon Coast area, more than any other in the region, is exposed to major winter storms. Storms frequently move on shore, with quite violent winds.

Population: County population is approaching 21,000. Population within the basin is currently estimated at 11,305. The area's recreation and tourist visits are estimated at 2.4 million visitor days annually.

2.2.4 Land Use and Existing Agricultural Practices

Land uses in the watershed include 323,050 acres of forest land, 23,540 agricultural acres, 10,980 stream, river and bay acres and 5,950 urban acres.

The primary agricultural industry is dairying, which involves approximately 12,190 acres. An additional 11,350 acres of farmland are used for related production of hay and silage, and other types of livestock.

Agricultural practices (BMPs) include pasture and hayland planting, pasture and hayland management, open ditches and animal waste storage facilities within the project area. Most farms did not have complete animal waste management systems prior to RCWP. Dairy operations had manure accumulation areas which were not roofed or curbed. Three roofed solid manure storage facilities existed within the project area. Manure runoff occurred during rainstorm events. Liquid manure storage facilities were not sufficient to store manure during the winter months. Consequently, manure was often spread when climatic and soil conditions were unfavorable.

Only thirty-three animal confinement buildings were adequately guttered with runoff water outletted in an area free of manure. On many farms this water ran through manured areas and into open water courses or into existing liquid manure tanks. Milk parlor and/or milk house wastes generally were outletted into an open water course.

2.2.5 Project Justification

Waters of the Tillamook Bay Drainage Basin were associated with a variety of beneficial uses. The identified beneficial uses are:

- Public Domestic Water Supply
- Private Domestic Water Supply
- Industrial Water Supply
- Commercial Shellfish Industry
- Irrigation
- Livestock Watering
- Anadromous Fish Passage
- Salmonid Fish Rearing
- Salmonid Fish Spawning
- Resident Fish and Aquatic Life
- Wildlife and Hunting
- Fishing
- Boating
- Water Contact Recreation
- Aesthetic Quality
- Commercial Navigation and Transportation

Oregon Department of Environmental Quality (DEQ) has established water quality standards to protect these beneficial uses. The standards specify the maximum pollutant concentration levels in Oregon's waters that can exist without affecting the beneficial uses. If standards are meet, water quality is suitable for the identified beneficial use.

Fecal coliform standards (1) for the Tillamook Drainage Basin are:

- The bay's estuarine shellfish growing water cannot exceed a fecal coliform median concentration of 14 organisms per 100 milliliters with not more than ten percent of the samples exceeding 43 organisms per 100 milliliters.

- The rivers' water cannot exceed 200 fecal coliforms per 100 milliliters based on a minimum of five samples in a 30-day period with no more than ten percent of the samples in the 30-day period exceeding 400 organisms per 100 milliliters.

- Many of the project area's animal waste disposal problems were complicated, requiring expensive solutions. Costs were too high for many dairy operators to afford the improvements without substantial financial assistance.

- The RCWP allowed producers to solve manure handling problems and remain in business. These improvements helped stimulate the local economy which was depressed by today's standards.

- The project would assure that shellfish harvesting could continue without the constant threat of Food and Drug Administration's (FDA) decertification. Decertification would prevent interstate shipment of oysters. Such action would have a severe economic impact on the oyster industry. The project would also sustain a healthy dairy and related food processing industries by providing jobs.

2.3 Project Goals and Objectives

2.3.1 Findings and Recommendations

Findings

- The Tillamook Project found that setting initial BMP component goals was very difficult. An initial inventory of all critical dairy operations as to BMP needs would have been helpful.

- Other programs were effective for installing certain BMPs which included tile drainage, fencing, streambank protection and critical area plantings. These programs supported the RCWP and were applicable to those operations not considered critical. Collectively, these operations have a potential for contributing to the pollution problem.

- Farm visits are required to identify critical dairy operations. It is best to conduct these visits during the wet season.

- Once animal manure systems are installed, different management is required. BMP installation can be accomplished within a short period of time but proper management and maintenance of the systems are long term commitments. Education is a continual process.

- Project participation requires an aggressive information and education program. The Tillamook project found the USDA Agriculture Stabilization and Conservation Service (ASCS) and Tillamook County Creamery Association (TCCA) newsletters better for informing potential participants than the local radio or newspaper. Best results were achieved by an informed TCCA field representative. His producer contacts, resulted in a high rate of producer participation.

- Local crop nutrient uptake data is required to develop adequate manure utilization specifications. Oregon State University Extension Service is conducting a "Nutrient Uptake Study". This study will localize the crop nutrient uptake data. It is projected the result of this study will require modifying existing waste (manure) utilization specifications.

- Information and Education (I&E) and water quality monitoring activities must be adequately funded for the project's life. Staffing can be affected by local or state budget cuts which are beyond federally initiated project's control. In Tillamook both the County Extension Service (CES) and DEQ budget cuts adversely affected the original program commitments and accomplishments.

- The Tillamook Project found that professionally developed slide talks and displays were effective in informing the general public about the RCWP. Kiwanis, Lions, Farm Bureau and other groups have been informed using slide presentations. A display has been used at the county fairs, local banks and TCCA Cheese Factory. The display rack includes colored pictures and captions that identify both the pollution problem and BMPs installed to correct the problem.

- Financial support must be available. Tours and meetings for heads of the local financial community were found beneficial. This assisted RCWP participants in obtaining their portion of BMP installation costs.

- Factors affecting implementation were high interest rates and the 1982 Omnibus Budget Reconciliation Act. This act required dairy producer marketing sale deductions. Deductions occurred when the Commodity Credit Corporation projected 5 billion milk equivalent pounds or more for the upcoming fiscal year. Market sale deductions were 50 cents per hundred weight of milk production. These assessments affected the RCWP participants' cash flows. Participants did not have dollars to install BMPs.

- The Tillamook RCWP Project has reduced the use of commercial fertilizer.

- Early in the project's implementation, Tillamook's construction economy was depressed. RCWP helped stimulate local construction and the county's economies.

- Local budget cuts prevented a continuous and coordinated I&E effort in the Tillamook Project.

Recommendations

- Future projects should encourage the use of Agricultural Conservation Program (ACP) or other state and local program funding sources in conjunction with the project funds (RCWP). This would encourage the use of funds for specific BMPs based on their costs and the project limitations. The effect would be that major pollution problems could be solved using the project's higher funding levels to install recommended expensive BMPs. Less expensive BMPs could be installed under ACP, state or local programs. The producer would have one overall plan, even though BMP funding may be allocated from two or more programs.

- Future projects should provide adequate funding at the local level for I&E activity. Local budget restraints can cause a severe cutback on these necessary activities.

- A United States Department of Agriculture (USDA) program is needed to assist participants finance their portion of the BMP installation costs. A low interest loan program would reduce the contracting time frame for BMP installations. Water quality improvement would be expected to occur sooner. Less water quality monitoring would be required. Also, the project would not be affected by such programs as the 1982 Omnibus Budget Reconciliation Act, Gramm-Rudman Act, commodity prices or high interest rates. Agricultural producer's cash flow requirements would be maintained.

- In cases where baseline data is not available, an additional two years should be added to the project's start-up time. At least two water year's water quality baseline data is necessary and the existing economic situation needs to be accessed prior to the project's implementation.

- Dedicated project dollars are needed for a water quality monitoring program. Monitoring is expensive and requires extensive time commitments. A program should not be curtailed by state budget cuts if water quality improvement trends require documentations.

2.3.2 Water Quality Goals and Objectives

A. Final Goal

The final goal is a 70 percent reduction in fecal coliform bacteria entering the shellfish growing waters of Tillamook Bay.

B. Initial Goal

The initial goal was a 30 percent reduction in sediment and a 70 percent reduction in fecal coliform bacteria entering the shellfish growing waters of Tillamook Bay.

C. Adjustments and Refinements

In 1983, the interagency review team suggested the 30% sediment reduction goal be dropped. The Tillamook Bay Project did not include provisions for treating forestland within the critical area where most of the sediment originated. Almost all of the agricultural land is in parmanent pasture and erosion is not a problem. Agricultural land comprises only a small portion of the basin. Therefore, the Local Coordinating Committee (LCC) removed the sediment reduction goal.

2.3.3 Implementation Goals and Objectives

A. Final

Table 2-1 identifies the final implementation goals. These goals include all programs within the Tillamook Project. Programs other than RCWP used to achieve these goals are:

- ASCS's Agricultural Conservation Program (ACP) and Long Term Agreements (LTA)
- Oregon's Governor's Watershed Enhancement Program (GWEB)
- Oregon Department of Fish and Wildlife's Programs
- Oregon's Youth Conservation Program (OYCC)

Table 2-1 also indicates the number of farms, as of December 31, 1990, having installed a specific BMP, units installed and the percentage of goals achieved.

Table 2-1: Tillamook Bay Project BMP Goals as of December 31, 1990

BMP NUMBER	UNITS	PROJECT GOAL	FARMS WITH BMP	UNITS INSTALLED	% OF GOAL ACHIEVED
1-a PASTURE AND HAYLAND MANAGEMENT	Ac	704	11	377	53.5%
1-b PASTURE AND HAYLAND PLANTING	Ac	450	10	121	26.9%
2-a-1(DRY) WASTE STORAGE STRUCTURE	No	100	70	77	77.0%
2-a-1(LIQUID) WASTE STORAGE STRCTR	No	105	65	72	68.6%
2-a(2a) GUTTERING	Ft	52,000	77	58,834	113.1%
2-a(2-b) ROOFING	Sq Ft	490,500	80	425,200	86.7%
2-a(3) BURIED MAINLINE	Ft	21,290	13	30,715	144.3%
2-b WASTE TREATMENT LAGOON	No	1	1	1	100.0%
2-d-1 CONDUIT	Ft	1,320	3	622	47.1%
2-d-2 CURBING	Ft	11,980	50	5,948	49.6%
2-e DIKE	Ft	45	0	0	0.0%
2-f DIVERSIONS	No	58	29	38	65.5%
2-g SUBSURFACE DRAIN	Ac	1,462	50	1,949	133.3%
2-h SURFACEDRAIN/MAIN/LATERAL	Ft	4,000	6	14,043	156.0%
2-i WASTE MANAGEMENT SYSTEMS	No	101	47	47	46.5%
6-a PIPELINE	Ft	8,150	1	2,150	26.4%
6-b TROUGH OR TANK	No	20	1	3	15.0%
6-c STOCK TRAILS AND WALKWAYS	No	6	4	5	83.3%
10-a STREAMBANK PROTECTION	Ft	0	6	2,416	100.0%
10-b FENCING	Ft	15,515	7	17,154	110.0%
11-a CRITICAL AREA PLANTING	Ac	25	8	8	32.0%
12-a WATER CONTROL STRUCTURES	No	6	5	5	83.3%
15-a WASTE UTILIZATION	Ac	8,805	67	6,061	68.8%

B. Initial

Eighty farms were identified as needing animal waste management systems installation or up graded to solve critical water quality problems. The LCC goaled 75 dairy operations for treatment. On-going ACP projects solved some of the water quality problems. The following three BMPs were initially identified for the Tillamook Bay Project:

- BMP-1 Permanent Vegetative Cover
- BMP-2 Animal Waste Management System
- BMP-10 Stream Protection Systems

Table 2-1 lists BMP components and units identified to treat the 80 farms. These BMPs were estimated in the 1981 Tillamook Bay RCWP Application (2) are listed below.

Table 2-2: RCWP Initial Project Goals

BMP NUMBER		UNITS	GOAL
BMP-1	Permanent Vegetative Cover		
1-a	Pasture and Hayland Management	ACRES	8,000
1-b	Pasture and Hayland Planting	ACRES	1,500
1-c	Irrigation Water Management	ACRES	2,000
BMP-2	Animal Waste Management Systems		
2-a	Animal Waste Storage Facility	NUMBER	25
2-b	Critical Area Planting	ACRES	40
2-c	Drainage, Land Grading	ACRES	30
2-d	Diversion	FEET	5,280
2-e	Pumping Plant for Water Control	NUMBER	10
2-f	Fencing	FEET	58,080
2-g	Structure for Water Control	NUMBER	10
2-h	Waste Utilization	ACRES	8,000
2-i	Dike (Confinement Area)	FEET	2,000
2-j	Grassed Waterway or Outlet	ACRES	30
2-k	Subsurface Drainage	ACRES	2,000
2-l	Surface Drainage	FEET	36,000
2-m	Guttering and Roofing	NUMBER	69
2-n	Concrete Curbing	NUMBER	2,500
BMP-10	Stream Protection System		
10-a	Stream Channel Stabilization	FEET	3,000
10-b	Livestock Exclusion	ACRES	25
10-c	Pipeline	FEET	19,800
10-d	Trough/Tank, Washing Facility	NUMBER	30
10-e	Cleaning and Snagging	FEET	86,400

C. Adjustments and Refinements

During the 1981 Plan of Work development, adjustments were made to BMPs as per NCC prescribed format. Guttering and roofing were separated as components. Waste Treatment Lagoon was removed from the Waste Storage Structures and made a component of BMP-2 Animal Waste Management Systems. Buried manure mainline, conduit and stock trails and walkways were added as BMP components. These practices were identified during the initial RCWP contract development. Units were also changed for some BMP components to coincide with units used for cost-share payment determinations. Implementation goals were readjusted for several BMPs. Table 2-3 lists adjusted BMP implementation goals required to treat 75 dairies.

Table 2-3: RCWP BMP Implementation Goals - 1981

BMP	NAME	UNITS	GOAL
BMP-1	Permanent Vegetative Cover		
1-a	Pasture and Hayland Management	ACRE	6400
1-b	Pasture and Hayland Planting	ACRE	700
BMP-2	Animal Waste Management Systems		
2-a-1	Waste Storage Structure	NUMBER	100
2-a(2-a)	Guttering	FEET	38,640
2-a(2-b)	Roofing	SQ.FT.	160,000
2-a(3)	Buried Mainline	FEET	26,800
2-b	Waste Treatment Lagoon	NUMBER	1
2-d-1	Conduit	FEET	750
2-d-2	Curbing	FEET	256
2-e	Dike	FEET	2,100
2-f	Grassed Waterway or Outlet	ACRE	25
2-g	Subsurface Drain	ACRE	1,500
2-h	Surface Drain, Main or Lateral	FEET	15,000
2-i	Waste Management Systems	NUMBER	80
BMP-6	Grazing Land Protection Systems		
6-a	Pipeline	FEET	8,400
6-b	Trough or Tank	NUMBER	26
6-c	Stock Trails or Walkways	NUMBER	18
BMP-10	Stream Protection		
10-a	Streambank Protection	FEET	420
10-b	Fencing	FEET	16,320
BMP-11	Permanent Vegetative Cover on Critical Areas		
11-a	Critical Area Planting	ACRES	25
BMP-12	Sediment Retention, Erosion, or Control Structures		
12-a	Structure for Water Control	NUMBER	6
12-b	Pumping Plant for Water Control	NUMBER	2
BMP-13	Improving an Irrigated and/or Water Management System		
13-a	Irrigation Water Management	ACRES	1,500
BMP-15	Fertilizer Management		
15-a	Waste Utilization	ACRES	6,400

In 1982 the LCC and SCC determined all 80 dairy operations initially identified as requiring treatment, must be treated if project's goals and objectives were to be achieved. Adjustments to goals were made for tracking the BMPs on the additional dairy operations.

LCC farm visits in 1983 revealed a greater number of critical animal waste pollution problems than originally anticipated in 1981. Critical operations were increased from 80 to 95. The LCC believed it was essential to treat all 95 critical dairy operations if the Tillamook RCWP was to be effective. BMP implementation goals were adjusted to reflect the additional farms requiring treatment.

Refinements were also made in the Waste Storage Structure, BMP 2, component. Dry and liquid manure storage facilities were listed as separate components. This adjustment was primarily for improving the BMP tracking system and developing SCS field office workload estimates.

In 1985, the LCC once again revaluated the critical dairy operations. An additional 11 farms were considered critical. A total of 106 operations were considered critical and needing treatment. BMP implementation goals were adjusted to reflect additional BMPs required to treat these operations.

From 1986 through 1990, only minor BMP implementation goal adjustment occurred. By late 1986, the BMP tracking system was in place. All RCWP BMPs were entered in a computer.

2.3.4 I & E Goals and Objectives

A. Final

For 1991 and beyond, goals and objectives are basically:

- Focus producers' attention on the importance of maintaining BMPs and their proper management so a water quality improvement trend continues.

- Provide producers localized crop nutrient uptake data.

- Work to improve producers waste utilization programs.

- Monitor reduction of agricultural related pollution in Tillamook Bay and keep the public informed of progress.

B. Initial

- Create and implement an educational program to accomplish the goals set forth in the administrative and technical work plans.

- Increase public understanding of water quality problems.

- Increase public understanding of solutions (BMPs) to agriculture water quality problems.

- Increase public's understanding of the RCWP program.

- Target audiences in critical areas.

- Provide information and educational opportunities necessary to encourage critical area producers to participate in the RCWP program.

C. Adjustments and Refinements

In 1982, the primary objective was informing everyone about RCWP. The goal was to achieve project support. This was accomplished by conducting tours and/or meetings for the following:

- Political and Agency Leaders
- USDA Washington D.C. Leaders
- Oregon Board of Agriculture
- Building Contractors
- Tillamook County Creamery Association (TCCA) Management
- Financial Institutions
- Project Area Participants

The local radio station and newspaper were used extensively to inform the public about the RCWP. The TCCA and ASCS newsletters were used to target potential participants in the critical areas.

The TCCA field representative with an understanding of RCWP, assisted producers in realizing their need for manure management and pollution control. Through producer contacts, critical operations received information concerning RCWP.

Late in 1983 and early 1984 the information and education program was limited. Extension Service staff was reduced due to cuts in the county budget. Some I&E activities were undertaken by Oregon State University with radio announcements and news articles being developed and released.

The Tillamook County SWCD assumed a portion of the I&E responsibility by preparing a slide presentation on the RCWP. With assistance from the Oregon State Department of Agriculture, Division of Soil and Water Conservation, a Tillamook Bay Water Pollution Control Project display was developed. The primary emphases was towards informing the public about the RCWP.

During the later stages of the project the education and information component had three major objectives:

- Work with project participants to insure an understanding of BMPs available and how these practices could change management requirements for their dairy operations.

- Continue to maintain an RCWP awareness and understanding with the remaining potential critical area participants.

- Obtain local manure nutrient concentration data, soil fertility, commercial fertilizer use and pasture management practices. Analyze and make recommendations to RCWP participants on proper manure utilization and pasture management.

2.3.5 Economic Evaluation Goals and Objectives

A. Final

Final economic goals and objectives are the same as the initial.

B. Initial

The 208 Plan ("Tillamook Bay Drainage Basin Agricultural Non-point Source Pollution Abatement Plan")(3) identified the economic impacts of reducing agriculture related pollution. Agriculture producers with water quality pollution problems face certain economic costs. However, it was the intent of the 208 Plan to minimize costs. The plan outlined a cooperative program relying on local initiatives to solve local problems. The final costs for correcting an agriculture related pollution program was left largely with the producer.

The economic impact on an agricultural producer would depend upon the extent of the water quality problem, productivity of the farm operation, present financial condition, availability of funds and interest rates.

BMP implementation would increase some production expenses, with a low income producer being more adversely affected than a high income producer.

Producer's income is influenced by factors other than milk prices and production costs. An example was the 1982 Omnibus Budget Reconciliation Act implemented in December 1982 to September 1984. During this time, Tillamook County's dairy economy lost more than 2.7 million dollars. The Act presented farmers with cash flow problems. Consequently, less money was available for implementing BMPs. High interest rates also affected implementation.

The RCWP economic goals and/or objectives were:

- Reduce the FDA's threat to withdraw certification of shellfish growing areas. This certification is required for oyster interstate shipments.
- Reduce frequency of shellfish harvesting closure in Tillamook Bay due to high fecal coliform counts.
- Help sustain a healthy and economic dairy and related food processing industries which stimulates the local economy by providing jobs.
- Keep producers in business by assisting them solve manure handling problems.
- Reduce long term energy requirement by lowering commercial fertilizer needs.
- Improve and/or prevent revenue losses generated by fishing, clamming, scuba diving, sailing, swimming and recreational activities.
- Boost the local construction economy through RCWP.

C. Adjustment and Refinement

Goals and objectives remain the same. No adjustments or refinements have been made.

2.3.6 Water Quality Monitoring Goals and Objectives

A. Final

Due to budget restraints, the water quality monitoring strategy changed in 1987. Tillamook County and the Oregon State Health Department have assumed a financial role in the Tillamook Bay monitoring program.

The water quality monitoring goal is to measure changes in water quality. Without the Tillamook Bay Commercial Sanitation Management Plan(4), the oyster industry in Tillamook County is endangered.

The monitoring objective is to classify and/or monitor commercial shellfish growing areas. Data from the bay's 14 sampling sites are used to classify and/or reclassify shellfish growing areas as either "prohibited" or "conditional approved" for commercial shellfish harvesting.

Tributary sampling has been reduced to seven sites. These sites include the five original major rivers plus one slough. Primary objective is to monitor the water quality trend. Monitoring sites were reduced due to budgetary restraints.

B. Initial

In 1979, the Tillamook Bay Bacteria Study(5) was initiated to identify the source and extent of fecal coliform pollution occurring in Tillamook Bay and its watersheds. The study's objectives were:

- Describe elevated fecal coliform affects on the bay and its tributaries.

- Identify, under various weather conditions, fecal coliform densities in the bay and its drainage basin.

- Identify sources contributing significantly to fecal coliform problems in the bay.

Seventy-one sample sites were identified on the five major rivers and/or their tributaries. These sampling site selections were based on:

- Land use — above and below a specific land use or a change in land use along the stream continuum, such as the forest-agricultural boundary.

- Small watersheds having only one or two land uses such as forestry or forestry—agriculture or forestry—urban.

- Potential site specific fecal source locations such as a county park.

- Accessibility to sample station and safety in taking samples during storm conditions, preferably from a bridge.

There were 14 bay sites identified. These sites were selected by considering:

- Previous sample stations
- Potential fecal source locations
- Shellfish growing area locations
- Accessibility to stations during low tides
- Safety in taking samples during a storm

Four weather conditions were sampled during December 1979 to November 1980. Storms were selected based on rain intensity, soil saturation conditions and predicted potential fecal bacteria source discharge.

Weather conditions selected were:

- A heavy rain on saturated soils. Sampling occurred during a 2.5 inch rainfall in 24 hours on saturated soils.

- A rain after a period of dry weather. A series of storms occurring after 4 days or more of dry weather with the tributaries running low discharges was monitored.

- A dry weather sample during a low flow summer period. Sampling was conducted during a 48 hour no rain, "steady state condition". Sampling was designed to identify the "background" bacteria condition of the tributaries and bay.

- First "freshet" storm of the water year. Storm monitored was a 53 hour intermittent to steady rainfall period producing 1.27 inches of rain following a two day dry period.

C. Adjustment and Refinements

The "1981 RCWP Plan of Work"(6) identified the long range monitoring strategy. Sample selected tributaries solely within dairy operations, the major rivers and Tillamook Bay. The bay and major rivers would be sampled on a quarterly basis. During storm events, the selected small tributaries would be sampled more frequently. Most of the sampling effort would be in relation to BMP installation on the small tributaries.

For the RCWP monitoring, two types of small agricultural streams would be monitored.

- A stream where all dairy operations were contracted for RCWP improvements.

- A stream where at least one dairy operation had not contracted for improvements.

If declining levels in fecal coliform concentrations were seen in stream number 1 versus stream number 2, then it would be assumed that BMPs were effective. Failing on-site subsurface sewage disposal systems and malfunctioning sewage treatment plants located near the major rivers or Tillamook Bay would also be monitored for declining levels in fecal coliform concentrations. Comparing the results of the "agricultural streams" with the major rivers and bay monitoring results, would provide detailed knowledge of agriculture's contribution and subsequent reduction in the fecal coliform pollution in Tillamook Bay.

Objective of the monitoring program was to provide water quality data for identifying trends on fecal coliform levels in Tillamook Bay and selected tributaries. These trends would demonstrate BMP effectiveness for the RCWP and determine satisfactory progress in implementing the 208 Plan. Nine river and 14 bay sites were identified for sampling.

Small watersheds where BMPs had been applied would be a high priority throughout the life of the RCWP. The monitoring plan for water year 1981-1982 would be quarterly sampling at selected sites. Within each quarter, the sampling would attempt to sample different weather conditions. Those conditions were:

- 1st qtr.(Oct. 1 - Dec. 31) 1st rainfall that raises Wilson River flow above 500 cfs.

- 2nd qtr.(Jan. 1-Mar. 31) Rainfall after a period of dry weather or rainfall onsaturated ground.

- 3rd qtr.(Apr. 1-June 30) Major storm occurring late in the quarter.

- 4th qtr.(July 1-Sept 30) Low flow dry weather or summer storm occurring in late August.

In addition to quarterly samples, storm related samples would be taken in small streams to monitor BMP effectiveness.

Because of DEQ's budgetary restrictions within the ambient monitoring program, adequate water quality monitoring could not be done. DEQ realized the need for adequate monitoring. But, until increased funding was realized, monitoring could not be accomplished. A Memorandum of Agreement between the Oregon Department of Environmental Quality and USDA Agriculture Stabilization and Conservation Service was executed January 1, 1982. This memorandum committed DEQ to providing technical assistance with the RCWP Monitoring Program.

During 1983, the Tillamook County SWCD initiated a monitoring project for the tributaries. Objectives were:

- Evaluate best management practices effectiveness in reducing agricultural related pollution planned under the "Site Specific Planning Project"(7) and implemented under the RCWP. Information obtained from monitoring efforts would be used as necessary to refine and/or redirect BMP installation. Effective BMPs would be used in other agricultural related pollution areas in Tillamook County.

- Evaluate whether "Satisfactory Progress" was being made towards reducing agricultural related pollution.

Dr. Richard P. Maas, National Water Quality Evaluation Project representative from North Carolina University and John Jackson, Oregon Department of Environmental Quality, assisted Tillamook County SWCD develop the monitoring project. Twelve water quality monitoring stations were selected from the 71 original tributary sampling sites. Sampling sites were chosen to evaluate treated vs untreated watersheds. Monitoring sites were also established above and below dairy operations implementing BMPs.

The Tillamook City waste water treatment plant supervisor conducted fecal coliform tests on samples collected by Tillamook County SWCD from the 12 sites. Data results were submitted to DEQ for evaluation. The Soil Conservation Service (SCS) established and calibrated four new staff gauges needed for this monitoring project.

During the early portion of project monitoring, sampling was storm driven. In 1986 a change was made at the request of the National Water Quality Evaluation Project (NWQEP) team. Sampling is now conducted on random, prescheduled monthly intervals.

In May 1983, Tillamook County SWCD submitted a grant request the "Tillamook Drainage Basin Agricultural Non-point Source Pollution Abatement Monitoring Project"(8), under Section 205j of the Clean Waters Act to DEQ. This request was not funded until 1985.

In October 1986, DEQ's monitoring efforts continued by using the 205j grant funds. This effort was later suspended pending further BMP construction on more farms in the bay's watershed. During December 1-12, 1986, FDA conducted an intensive 12 day sampling of the bay and tributaries.(9)

2.4 Project Development

2.4.1 Highlights of Project Development

This section covers project expansion, institutional cooperation, changes in implementation and/or water quality monitoring, etc.

The Tillamook Bay RCWP has expanded several times, but not beyond the original boundaries of the watershed. Expansion was in the form of additional cost-share funds being allocated during the contract approval period. These funds allowed additional contracts to be written and approved which expanded the number of farms participating in the RCWP. The original participation goal of 75 percent was increased over the years to where 100 percent participation was thought possible, but not achieved. As the expiration date for approving contracts approached during July of 1986, the project ran out of money and time in which to write the last few contracts. Each time additional funds become available a few more participants would request a contract. This caused the reprioritization of those applicants not yet approved. If the total funding approved could have been allocated during the first year, planning and approval of contracts may have been simplified.

Several changes have occurred during the construction phase of this project. SCS designs and specifications have changed on some BMPs due to engineering requirements and building code changes.

2.4.2 Summary of Annual Achievements

Based on Fiscal year, October 1 thru September 30:

1981 Project Funded: $1,834,942 allocated for contracts.
First 3 contracts written and approved.

1982 35 contracts written, $1,442,452 approved.
$621,503 paid to 28 producers for BMP installation.

1983 $700,000 allocation increase for contracts.
23 contracts written, $1,004,366 approved.
$435,011 paid to 31 producers for BMP installation.

1984 $482,338 allocation increase for contracts.
10 contracts written, $400,628 approved.
$492,263 paid to 30 producers for BMP installation.

1985 $467,998 allocation increase for contracts.
8 contracts written, $386,865 approved.
$324,696 paid to 27 producers for BMP installation.

1986 $900,000 allocation increase for contracts.
25 contracts written, $1,200,767 approved.
$483,335 paid to 28 producers for BMP installation.

1987 $155,000 allocation increase for contracts.
$122,613 approved for revisions to contracts.
$628,670 paid to 47 producers for BMP installation.

1988 $53,801 approved for revisions.
$293,294 paid to 25 producers for BMP installation.

1989 $24,782 approved for revisions.
$184,345 paid to 20 producers for BMP installation.

1990 $2,393 approved for revisions.
$111,428 paid to 10 producers for BMP installation.

1991 As of December 31, $22,374 paid to 2 producers.

2.5 Changes in Land Use Patterns and Water Resource Management Throughout Project Period

2.5.1 Impacts and Effects of Federal Programs

For the most part, impacts or effects from other Federal Programs within the Tillamook County RCWP Watershed have been minimal.

As the expiration date for approving contracts during the five year RCWP prioritization and approval period approached, it became obvious not all farms could be funded. It also became obvious all farms in the project area needed treatment if the program was to be successful.

Under the USDA's Dairy Buyout Program only one contract was accepted in Tillamook County. This farm is located within the Tillamook Basin Watershed, and had a minimal effect on RCWP. Livestock on this farm consisted of 28 cows, 16 heifers and 4 calves.

Other Federal Programs such and PIK and CRP have had no effect on the project area. All farmland is pasture with no annual agricultural commodities being produced.

2.5.2 Impacts and Effects of Cropping and Chemical Use Changes

Use of agricultural land remains the same, pasture. Cropping has changed somewhat due to better pasture management and spreading of manure. Producers are able to store manure through wet seasons and apply it during dryer periods. This ability has greatly reduced manure runoff and according to participants the use of chemical fertilizers on pastures.

The Soil and Water Conservation District and Tillamook County have taken a leadership roll in controlling noxious weeds such as Tansy Ragwort and Thistle. Treatment of noxious weeds has progressed from chemical to biological control, reducing chemicals applied. This decreases the possibility of cows grazing treated pastures and the chemical contamination of milk. With a reduction in chemical use, surface water is less likely to be polluted adding to overall improvement of water quality.

2.5.3 Review of Changes in Population, Construction and other Factors

Within the Tillamook Bay Watershed Population has remained about the same with marginal growth in both urban and industry sectors.

Construction techniques have changed due to more restrictive building codes and SCS design specifications. Fluctuating costs of materials have increased construction expenses.

2.5.4 Impacts and Effects of RCWP

Land use patterns have not been effected by RCWP in Tillamook County. Agricultural land was devoted to pasture and hay prior to RCWP as it is today.

Water resource management has changed. RCWP provided funding for installing manure storage and handling facilities which area farmers could not have installed without assistance. Installation of BMPs has educated participants and others to the benefits of manure management systems.

Prior to RCWP, many producers had little or no manure storage facilities. Manure was spread every few days regardless of weather conditions. This allowed a great deal of manure to runoff the pastures and into nearby streams.

By installing manure storage and handling facilities, manure is no longer stacked in the rain. It is now stored in covered structures with rain water being diverted away from manure accumulation areas by means of roofing, gutters, downspouts and outlets. This provides a dryer and cleaner environment for animals. Fresh water contamination has been greatly reduced by eliminating excess water runoff from passing through manure accumulation areas.

Manure storage facilities allow producers the flexibility to hold and apply manure on pastures when it is more advantageous for the growing of grass. This has resulted in reduced chemical fertilizer applications and emphasized the value of manure as a fertilizer and not a waste product to be disposed of.

RCWP has also been a demonstration project. Farmers and various Government agency personnel have visited the area to see first hand the BMPs being installed and how they are improving water quality in Tillamook County. Several of these visits have resulted in similar projects being implemented in other regions of the country. The success of RCWP in Tillamook County has been directly responsible for three ACP Special Water Quality Projects being requested and approved for other river basins within the County.

Farmers from these areas have seen improvements within the Tillamook Basin. When cost-share assistance is available, they have been eager to install animal waste management systems on their farms.

RCWP has changed the way of life for many people in Tillamook County by providing education, technical and financial assistance for water quality improvement projects that would never have been experimented with or accomplished without the program.

3.0 Implementation Results

3.1 Findings and Recommendations

Findings

- The Tillamook Project used a rating system to identify critical agricultural operations. This system was helpful in prioritizing RCWP applications.

- The "Tillamook Bay Drainage Basin Agricultural Non-Point Source Pollution Abatement Plan" (208), and the Tillamook Bay Bacteria Study, Fecal Source Summary Report were important documents in developing the rating system and identifying critical river sections.

- A manure management system is more effective in solving agricultural waste problems than a single component. The system must have participant's support and commitment. Each component must be based the site specific requirements and participant's preference.

- In a high rainfall area, like Tillamook County, managing and/or diverting rainwater away from animal manure accumulation or storage areas is an important consideration in BMP planning and implementation.

- Traditional BMP practices in the Tillamook Project were not adequate to solve manure runoff problems. Additional practices such as roofs, gutters, downspouts, outlets, filling existing open ditches, curbs, conduits, and buried manure mainlines were needed.

- Strong local leadership is a key element in a successful manure management project. The Tillamook project had strong support and commitment from the Soil and Water Conservation District and the agriculture industry, (Tillamook County Creamery Association).

- Project participants' objectives change during a ten-year period. New landowners, changes in size and type of BMPs originally planned and changes in landowners' objectives occurred. Contract modifications are a major part of the workload in the Tillamook Project.

- Contract violations will occur. Strong local leadership (peer pressure) is a key element in correcting these violations. In the Tillamook Project, ASC County Committee and Soil and Water Conservation District letters are effective in resolving most violation problems. A farm visit from the Tillamook County Creamery Association field representative has also been very effective.

- Changes in local and/or state regulations during project implementation will affect the implementation process. Tillamook County began requiring agricultural building permits in eight years after the project started. The State of Oregon also required confined animal feeding (CAFO) permits during 1990. These changes resulted in additional reviews prior to BMP implementation.

- The Tillamook RCWP required extensive SCS staff hours. SCS field office staff included a District Conservationist, Soil Conservationist, Soil Conservation Technician and a Civil Engineer.

- A lack of manure storage facility designs existed prior to the project. Larger volume liquid and solid manure storage facility designs were needed. Extensive SCS design time was required before planning and implementation could proceed.

Recommendations

- BMPs must be developed at the local level. The agricultural industry and potential participants must be involved in BMP identification.

- Local decision makers must have flexibility in choosing BMPs for cost-sharing. Traditional practices may not be adequate to solve all water quality problems.

- An adequate technical staff must be available. The Tillamook Project with 101 farms under contract could not be efficient with less than a soil conservationist, soil conservation technician and a civil engineer in addition to the district conservationist.

- Local contract violation decisions must be supported at the state and national levels.

3.2 Critical Area Treatment

3.2.1 Definition of Critical Area

The Tillamook Bay Rural Clean Water Application considered all dairies located within the Tillamook Bay Drainage Basin as potential critical areas. This included animal confinement areas and pasturelands on which manure was applied. Oregon Department of Environmental Quality's (DEQ) 1979-1980 Water Quality Monitoring Project, identified tributaries as having the greatest agricultural water quality impact on shellfish growing waters of Tillamook Bay.

The 1980 208 Plan ("Tillamook Bay Drainage Basin Agriculture Non-point Source Pollution Abatement Plan") identified these tributaries. Tillamook County Soil and Water Conservation Districts (SWCD) subsequent "Site Specific-Agricultural Pollution Abatement Plan" placed pollution abatement plan development priorities on 60 of the 115 dairy operations. The most critical operations were those meeting the following criteria:

- Valid water quality complaints filed with the DEQ.

- Agricultural operations adjacent to open water courses and characterized by poorly drained soils.

- Agricultural operations identified through the Tillamook County SWCD's agricultural operation inventories.

- Tillamook, Trask and Wilson River Drainage Basins. These rivers flow over the oyster and clam beds. They had the greatest water quality impact on the Bay's shellfish growing waters.

Proposed RCWP cost-share assistance concentrated on project area farms with critical pollution problems. Priorities were based on the Tillamook County SWCD's criteria identified in the 208 Plan. Seventy-five farms, which included 8,000 acres receiving manure, were considered critical in the application.

The critical area definition was refined when the Local Coordinating Committee developed the 1981 Project's Plan of Work. A rating system was developed, based on the Tillamook Bay Bacteria Study, Dr Jong Lee's observation(10), Soil Survey(11), and flood plain maps(12).

The Bacteria Study indicated that fecal material on the ground surface adjacent to ditches and streams is likely to enter open water courses soon after a rainstorm. This fact was supported by high fecal bacteria levels in streams where barnyards were adjacent to water courses.

Dr Lee concluded: "Pollution input to Tillamook Bay assumes a greater significance when the source is located near the Bay or at the lower ends of the tributaries. Clearly any improper manure management practices there have to be dealt with. This should be the first order of business."

The SCS Soil Survey, indicates there are 5,300 acres of poorly to imperfectly drained soils in the Tillamook Basin. Large quantities of manure were applied to these soils during wet weather.

Flood plain maps indicate a larger number of dairy operations located in the flood plain. The 208 Plan identified dairy operations located in the floodplain as critical.

A computer program played an important role in defining critical areas(13). This program was supported in part by U.S. Environmental Protection Agency funds.

The model considered precipitation effects, season, waste storage and application methods, bacteria die-off in storage, and on the land surface, bacteria soil profile infiltration, soil characteristics, overland bacteria(runoff) transport, and buffer zones.

At the onset, this rationale created the Tillamook Bay RCWP rating system for defining critical areas and/or dairy operations. The higher the score the more critical the area or operation. The rating system was:

A. Confinement areas adjacent to open water course:
- (100 pts.) Less than 300 feet
- (50 pts.) Between 300 feet and 1000 feet
- (0 pts.) Greater than 1000 feet

B. Poorly drained soils where manure is spread:
- (60 pts.) More than 40 acres
- (40 pts.) Between 20 and 40 acres
- (20 pts.) Less than 20 acres
- (0 pts.) No poorly drained soils

C. Number of animal(s) per acre:
- (40 pts.) More than 3 animals
- (20 pts.) Between 3 and 2 animals per acre
- (0 pts.) Less than 1 animal per acre

D. Operation located in floodplain:
- (30 pts.) Confinement area in floodplain
- (20 pts.) More than 40 acres in floodplain where manure is spread
- (10 pts.) Between 10 and 40 acres in floodplain where manure is spread

E. Located in the Tillamook River Watershed
- (9 pts.)

F. Located in the Trask River Watershed
(8 pts.)

G. Located in the Wilson River Watershed
(7 pts.)

H. Located in the Miami River Watershed
(6 pts.)

I. Located in the Kilchis River Watershed
(5 pts.)

J. Tidewater influenced area
(5 pts.) Up to head of tidewater
(3 pts.) Head of tidewater to River Mile 8
(0 pts.) Greater than River Mile 8

K. Streams that were identified by DEQ's monitoring program as being polluted by dairy operations
(5 pts.)

L. Valid DEQ water quality complaint
(2 pts.)

In 1983, The Local Coordinating Committee (LCC) discovered that when the highest rated critical dairies were funded, the remaining applications had nearly identical scores. The County ASC Committee(COC) was concerned that the rating system alone would not identify remaining dairies as having serious manure related pollution problems. Remaining dairies were further away from open water courses and were higher in the watershed than those previously planned and funded.

The COC appointed a team consisting of one member each from the COC, SWCD Board, and the Tillamook County Creamery Association (TCCA). This team visited the remaining applicants' farms. The SCS District Conservationist, ASCS County Executive Director and County Cooperative Extension Agent accompanied the team. Following the team's farm visits, 15 additional dairies were considered critical. Additional points for application that would have all dairies in a sub-watershed under contract were added. Achieving total pollution abatement along a small tributary and/or stream section was the rationale. DEQ also assisted in prioritization of these applications.

3.2.2 RCWP - Accomplishments

As of December 31, 1990, 43 percent of the critical dairy operations, representing 48 percent of the critical acres have been treated. This represents 193,595 tons or 60 percent of the manure produced within the Tillamook Bay Drainage Basin. This manure is contained or managed in such a manner that prevents it from entering the streams and bay.

Table 3-1 identifies project accomplishments as of December 31, 1990.

3.3 BMP Implementation

3.3.1 Description of Each BMP and the Problem It Addresses

BMP-1 Permanent Vegetative Cover

A permanent vegetative cover established on poor condition pastures where manure is applied.

PURPOSE

Reduce manure runoff from identified poor condition pastures where runoff contributes to a water quality problem.

COMPONENTS:

1-a Pasture and Hayland Management

1-b Pasture and Hayland Planting

RATIONALE:

High quality managed pastures prevent manure runoff into open water courses. Manure applied in an acceptable manner on high quality pastures remains on the pastures. Water quality improvement occurs.

BMP-2 Animal Waste Management Systems

A system having one or more needed components installed for proper manure handling and management. Systems include runoff prevention from manure accumulation areas.

PURPOSE

Manage and handle manure in a manner that prevents manure runoff into surface waters.

SYSTEM COMPONENTS:

1. WASTE STORAGE STRUCTURE

A fabricated structure for temporary liquid or solid manure storage.

PURPOSE

Increase manure storage and provide an adequate manure handling system.

COMPONENTS:

2-a-1 Solid Manure Storage Facility

2-a-1 Above Ground Liquid Manure Storage Facility

2-a-1 Below Ground Liquid Manure Storage Facility

Site Preparation

Rock/Fill

Pump and/or Agitator

2-b Earthen Storage Pond

RATIONALE:

Increased manure storage and improved handling provides the flexibility required for proper manure application when favorable soil and climatic conditions exist.

This minimizes manure runoff to streams and helps maintain the nutrient content. Storage structures reduce the number of manure applications required. They assist producer time application to match pasture fertility requirements. This flexibility prevents manure runoff. Water quality improvement results.

2. WASTE TRANSFER SYSTEM

Diversions, structures, pipes, conduits or equipment that transports or confines manure to manure accumulation areas.

PURPOSE

Transports liquid manure to a manure storage facility, between storage facilities or to fields for safe application. Also prevents manure accumu lation area runoff.

COMPONENTS:

2-a(3) Buried manure mainlines
2-d-1 Conduits
2-f Pipes
2-f Concrete gutters and grates
2-f Concrete curbs

RATIONALE:

Properly stored, handled, and controlled manure reduces pollution sources. Water quality improvement results.

3. ROOF WATER MANAGEMENT OR ROOFING FOR WATER CONTROL

Structures for collecting, controlling, diverting or preventing rainfall contact with manure.

PURPOSE

Prevents rain or roof water from flowing across concentrated manure accumulation areas and/or into manure storage facilities. Diverts clean rain into open water courses.

COMPONENTS:

2-a(2-a) Gutters, downspouts and outlets
2-a(2-b) Roofs

RATIONALE:

Rain water diverted away from manure accumulation areas prevents contaminants from entering open water courses. Water quality improve ment occurs. Roofed storage facilities, accumulation areas, and confine ment buildings guttered, downspouted and outletted, decrease manure storage requirements and potential pollution sources.

4. WATER TABLE CONTROL

Subsurface or surface drainage systems, water control structures, or other water conveyance structures that control water table and/or remove excessive surface water from fields that receive manure.

PURPOSE

Improve the soil condition for vegetative growth and its ability to receive manure by manipulating the water table and surface water during early spring and late fall.

COMPONENTS:

2-g Sub-surface drains
2-h Surface Drains, main or lateral

RATIONALE:

Excessive surface and subsurface water removal during early spring and late fall allows manure application on poorly to somewhat poorly drained soils during these periods. Removal improves nutrient uptake. This prevents manure runoff from these critical areas. Water quality improve ment results. Less expensive, smaller manure storage facilities required.

5. DIKE

An earth embankment that protects manured pasture against stream overflow.

PURPOSE

Prevent water course overflow onto pastures that receive manure or into confinement areas where manure accumulates.

COMPONENT:

2-e Dike

RATIONALE:

Dikes constructed adjacent to open water courses prevent overflow into manure accumulation, storage or manure application areas. Water quality improvement results.

BMP-6 Grazing Land Protection System

A grazing system that improves livestock distribution on pastures adjacent to open water courses.

PURPOSE

Provide livestock water and grazing access to pastures.

COMPONENTS:

6-a Pipelines
6-b Watering troughs
6-c Stock trails and walkways

RATIONALE:

Improved grazing distribution systems provides livestock watering facilities and pasture access without open water course access. Water quality improvement occurs.

BMP-10 Stream Protection Systems

A system that protects streams from livestock related pollution or streambank related sedimentation. System includes one or more components.

PURPOSE

Reduce livestock related pollution and sedimentation associated with direct stream access.

COMPONENTS:

10-a Streambank Channel Protection or Stabilization
10-b Fencing

RATIONALE:

Installed stream protection systems prevent direct livestock access to streams. They prevent manure deposition to the stream corridor. Protected streambanks also reduces sediment loads. System implementation improves water quality.

BMP-11 Permanent Vegetative Cover on Critical Areas

Permanent vegetative cover established to stabilize a livestock induced sediment source or critical pollution area.

PURPOSE

Reduce livestock related erosion or pollution along open water courses.

COMPONENTS:

11-a Critical Area Planting

RATIONALE:

Established riparian vegetation along open water courses reduces livestock related erosion and pollution. Water quality improvement occurs.

BMP-12 Sediment Retention, Erosion or Water Control Structure

Structures that control erosion, sediment, animal waste and chemical runoff from critical areas by regulating surface water elevations.

PURPOSE

Regulate and/or remove surface and/or floodwaters from critical pastureland used for manure application.

COMPONENTS:

12-a Structures for Water Control - Tidegates

12-b Pumping Plant for Water Control

RATIONALE:

Floodwaters or surface water removed in a timely manner, allows earlier manure application on these pastures. Runoff is prevented. Water quality improvement occurs. Having these pastures available for manure application decreases the manure storage requirement.

BMP-13 Improving an Irrigation and/or Water Management System

Controlled rate, amount and timing of irrigation water applied on pastures receiving manure.

PURPOSE

Use irrigation water effectively in managing and controlling crop moisture require ments, plant nutrient losses and manure runoff into open water courses.

COMPONENTS:

13-a Irrigation Water Management

RATIONALE:

Irrigation water application to manured fields based on crop requirements and soils water holding capacity will prevent runoff. Water quality improvement occurs.

BMP-15 Fertilizer Management

Manure utilized in an environmentally acceptable manner to maintain or improve soil, water and plant resources.

PURPOSE

Keep manure out of open water courses by applying manure on pastures in an environmentally acceptable manner.

COMPONENTS:

15-a Waste Utilization

RATIONALE:

Manure applied to pastures in an acceptable manner will prevent manure runoff into open water courses. Water quality improvement will occur. Acceptable guidelines:

- Manure should not be spread directly into an open water course or where runoff will enter an open water course.

- Manure should not be spread on fields when soil is saturated or when surface water is present.

- Fields receiving winter manure will not receive early spring application of commercial fertilizer until warmer weather when grasses can utilize the winter applied manure.

- No field should receive more than 4 applications of 50 pounds of nitrogen per acre per year.

- For winter manure application, observe weather forecast to minimize potential manure runoff. Do not apply manure when precipitation is expected for the short-range forecast.

- If available, winter applications should be restricted to well-drained soils.

- If well-drained soils are not available in winter, apply manure to a field with subsurface drainage systems.

- If neither well-drained or drained soils are available when manure must be applied in winter, use the fields furthest away from open water courses.

3.3.2 Acres or Units Treated or Served by Each BMP Implemented

3.3.3 Number and Proportion of Project Area Producers Implementing each BMP Under RCWP

Table 3-2 identifies the following BMP information for the 5 sub-watersheds and the total for the Tillamook Bay Drainage Basin:

1. Number of RCWP contracts
2. Number of RCWP contracts within the watershed having the BMP
3. Percent of RCWP contracts within the watershed having the BMP
4. BMP units planned
5. BMP units installed as of December 31, 1990
6. BMP units remaining for installation between December 31, 1990 and December 31, 1996
7. Percent of the BMP units installed
8. Critical acres that will be treated by the BMP
9. Critical acres treated by the BMP as of December 31, 1990
10. Critical acres that remain to be treated by the BMP between December 31, 1990, and December 31, 1996
11. Percent of the critical acres treated by the BMP as of December 31, 1990.

Table 3-2-1 (page 3-?) displays BMP component installation by year, as of December 31, 1990.

3.3.4 Discontinued BMPS Under RCWP

To date, there have been no BMPs discontinued.

3.3.5 Changes in BMP Emphasis

During the 1980 208 Plan development, SCS, CES, and Tillamook County SWCD representatives visited dairy farms in the project area. Visits were conducted to identify water quality problems and determine best management practice needs. The 208 plan indicated the principal surface water pollution problems were:

1. Animal Access to Streams: Some operations allowed uncontrolled livestock access to streams and rivers. This activity results in streambank erosion and manure pollution.

2. Runoff from Animal Confinement Areas: Confinement areas adjacent to open water courses have a high potential for water quality problems.

3. Field Manure Application: Field application during wet weather can contaminate surface water. Management that does not consider the climatic and soil conditions during manure application can create water quality problems.

Associated problems were:

- Spreading manure when fields have ponded water.

- During high intensity rainstorm, spreading manure on sloping fields that have a high water table.

- Inadvertent manure application in seeps or in open water courses.

- Heavy farm equipment caused soil compaction. That reduced soil infiltration rates. Manure runoff occurred.

- Soil sealing by over manure application.

4. Insufficient Manure Storage and Handling: Agricultural operations with inadequate manure storage capacities can cause water pollution. Facilities need sufficient capacities to store until climatic and soil conditions permit field application. Non-roofed manure accumulation areas adjacent to open water courses had manure runoff.

Project Strategy:

Keep rainwater off manure and manure storage areas, and when not possible, keep contaminated surface waters from reaching the streams or the Bay.

The Best Management Practices identified in the Tillamook Bay Rural Clean Water application were those practices that would implement the 208 Plan Strategy. Three BMPs were identified and requested. They were:

BMP-1 Permanent Vegetative Cover
BMP-2 Animal Waste Management Systems
BMP-10 Stream Protection System.

The LCC requested practices that reduced manure runoff and improved water quality. The Committee felt the traditional Agricultural Conservation Program (ACP) practices were not adequate to solve the identified water quality problems. Additional BMP components above the traditional were needed. These included roofs, gutters, downspouts, outlets, curbs, buried manure mainline and conduits.

Practices were selected and based on the following considerations:

- Manure is a valuable resource. Not a disposal byproduct
- Maximum nutrient retention
- Manure storage adequate to apply manure when grass can utilize the applied nutrients.
- Reduce commercial fertilizer usage
- Prevent manure runoff
- Prevent rainwater contact with manure
- Efficient manure handling.

During the NCC application review, concerns about additional BMP's arose. The requested BMPs and their components were not in the required format. It was requested, the project rewrite BMPs and components to correspond with Handbook 1-RCWP, Exhibit 29. The NCC requested that BMP-15 Fertilizer Management be considered. They also requested justification of the use and cost ($20,000) for a pumping plant. Other questions included: Is lowering the water table for animal waste considered drainage? Is it the most efficient and cost effective method?

In April 1981, the BMPs were revised as requested. The July 1981, Project Plan of Work included eight BMPs.

BMP-1 Permanent Vegetative Cover
BMP-2 Animal Waste Management System
BMP-6 Grazing Land Protection System
BMP-10 Stream Protection System
BMP-11 Permanent Vegetative Cover on Critical Areas
BMP-12 Sediment Retention, Erosion or Water Control Structures
BMP-13 Improving an Irrigation and/or Water Management System•
BMP-15 Fertilizer Management

Component item for the animal waste storage structure (BMP-2) was split into two components. Waste storage structure and waste treatment lagoon. The rationale was that each had different construction methods and costs. Because of heavy rainfall, lagoons would only be installed in isolated cases.

Adequate justification for land grading was not evident for NCC approval. LCC removed the component from the BMP-2 list.

LCC added Waste Management System to the BMP-2 list. Tracking completed or planned BMP-2 Animal Waste Management Systems was the rationale.

BMP-2 Components, curbing and conduit were included in the diversion component. Buried manure mainline was included as an integral component of a waste storage structure.

LCC submitted the following pumping plant justification: "Pumping plants are an integral part of the waste management system for a small number of dairies in the project area. Pumps are required where drainage systems are affected by tides. During periods of heavy rainfall and high tides the tidegates close. Surface water builds up because fields are enclosed by dikes. If surface water is allowed to accumulate, it floods the field. The surface water becomes polluted from animal wastes and it runs off into the waterways. When a pumping plant is installed, water level is lowered behind the tidegates. The tile drainage systems continue to work effectively by allowing rainwater to infiltrate the soil. Pumping plants often involve more than one dairy." The NCC accepted this component. It was included, along with structures for water control, in BMP-12 Sediment Retention, Erosion, or Water Control Structures.

LCC submitted the following justifications for the drainage, as to its effectiveness for water quality improvement and cost effectiveness:

> *Virtually all of the farmland in the project area is in permanent vegetative cover. It is used for grazing, green chop and/or silage. The installation of a tile drainage system permits manure application on the land over a greater time period. The water table must be lowered before additional water and manure can infiltrate into the soil. Without adequate field drainage, rainwater flows over the surface washing applied manure into an open water course.*

Tile drainage systems are installed on acreage needed for manure application. Waste storage needs are based on a manure management system that considers the acreage available for spreading manure. Weather conditions in the project area warrant a minimum six week storage capacity. It is more economical to install an adequate drainage system than to build additional manure storage. The economic data is included in Section 5.3.4.

The NCC accepted the drainage as a BMP-2 Animal Waste Management System component. At first, the LCC determined BMP-15 Fertilizer Management was not needed in the project area. Commercial fertilizer was being utilized on some farms. The NCC determined manure is a fertilizer, so the LCC adopted BMP-15. Waste utilization was included as a component under BMP-15, Fertilizer Management, on all approved contracts.

During the LCC best management practice determinations, clear and snagging was removed from the BMP-10 Stream Protection System Component list. Rationale was that cleaning and snagging is detrimental to fish habitat. Water quality improvements derived from cleaning and snagging would not offset the fish habitat losses incurred by implementing the practice.

During project planning in 1982, adjustment in the BMP-2 Animal Waste Management Systems occurred. Conduit, curbing site preparation, rock/fill, agitators, pumps, and buried manure mainlines were made separate components. Individual cost-share rates were needed for better planning and contract management.

The BMP project list did not change after 1983.

During 1984, the grassed waterway or outlet component was removed from the BMP-2 Animal Waste Management Systems list. Participants' plans had not included this practice. Since permanent pastures dominated the project area, there were no identified water quality problems that this practice could correct.

The Tillamook Bay Rural Clean Water Project application listed a 30% sediment reduction goal. In 1983 this goal was removed because most of the sediment was originating from forestland which the project did not include. Sediment originating from agricultural land is difficult to measure and is only a small portion of the total annual sediment loading entering watercoures and the Bay.

Manure problems associated with water quality degradation were well identified during 208 Planning. Adequate BMP identification and a critical area rating system helped justify the BMP originally emphasized. The planning process resulted in extensive farm planning preparation before the RCWP implementations. This critical pre-project planning results in a successful project. Agency regulations were not a barrier to RCWP implementation.

Planning and implementing waste management systems, rather than a single component which treats a symptom, prevent emphases changes. Recognizing the need for BMPs above the traditional ACP practices to solve agricultural related pollutions is a key element.

A combination of BMPs were needed for effective manure storage, handling, application and utilization. Innovative thinking and positive attitudes resulted in implementing a successful combination of BMPs that addressed the RCWP goals.

Best management practices selected were based on site specific needs as well as farmer preferences. These practices resulted in more efficient management, requiring less labor and creating drier barnyards with improved farmstead aesthetics. As a result, farmers support the project's water quality objectives and take pride in water quality improvements.

Tillamook County SWCD leadership and strong Tillamook County Creamery Association support are key elements in the successful manure management system implementation. Their involvement helps keep the project on tract and moving towards the identified goals. Consequently, only minor changes in BMP emphasis has occurred.

3.4 Contract Modifications and Violations

3.4.1 Total Number of Contracts

One hundred and thirteen RCWP contracts were developed.

3.4.2 Contract Cancellations and Modifications

Two contracts have been cancelled. The Tillamook County ASC Committee (COC) with the concurrence of the Tillamook County SWCD, SCS and the Oregon State ASC Committee, cancelled one contract at the owner's request. It was determined to be in the best interest of the government as only two minor BMPs had been installed and the owner was moving from the area. The farm is not for sale, but is not being operated as a dairy.

The other contract was cancelled due to the farm operator failing to complete a cost-shared BMP within the first year of the contract. This farm has now been sold and is part of another farm under contract.

Ten contracts have been modified due to changes of landowners. New landowners have requested revisions of existing contracts. The Conservation Plan of Operations (CPOs) were developed to address the new owners' animal waste management objectives.

There have been an additional 145 modifications involving the existing 101 RCWP contracts. Modifications were made primarily for:

1) Changes in originally planned BMP (size and type).
2) Deletion of BMP components not needed.
3) Addition of BMP components needed to prevent manure runoff.

3.4.3 Contract Violations

The following violations have been observed:

- Mismanagement of storage facilities (above ground liquid manure tanks)
- Improper use of facilities (Solid manure storage facilities)
- Broken gutters and downspouts
- Improper waste utilization
- Water quality violation

Improper management and lack of tank agitation have been the primary problem with above ground manure tanks. Lack of management has resulted in a crust forming on several tanks reducing the liquid storage volume. As a result, several tanks have overflowed. To date, four participants have been notified by letters from the Tillamook County SWCD and/or COC informing them of violations. Tillamook County Creamery Association's field representative has also contacted each participant to discuss tank management.

Four participants have also been notified of improper use of solid manure storage facilities. Facilities were used for corn silage or other feed storage and were not available for manure storage during wet weather conditions.

COC has written annual letters to all RCWP participants reminding them of RCWP contract requirements involving completed BMPs. Letters informed participants that facilities must be maintained and used for the purpose in which they were approved and cost-shared. The COC determined solid manure storage facilities must be available for manure storage from November 1 through March 1 each year. If a participant violates their RCWP contract provisions and is unwilling to cooperate, action will be initiated to reclaim cost-shared funds. Such action was initiated involving one RCWP participant. The participant appealed the COC's determination to the Oregon State ASC Committee which upheld the COC's decision. Participant appealed this action to ASCS in Washington D.C. where a compromise was agreed upon.

Broken gutters and downspouts have been noted on two RCWP facilities during Annual Status Reviews. ASCS has notified participants reminding them of requirements to maintain cost-shared facilities. Participants have made the required repairs.

Improper waste management involved either spreading manure, directly into an open water course or during inclement weather conditions when soils were saturated or ponded water occurred. This type of violation has occurred with six RCWP participants. All involved improper manure gun placement and/or use. Tillamook County SWCD wrote letters to the participants requesting that they be more careful in applying their manure.

One RCWP participant was reported to Oregon Department of Environmental Quality for a water quality violation. Participant was found in violation of the department's water pollution control facilities permit and a stipulated consent order was issued. This order required participant to install remaining BMPs scheduled in his RCWP Conservation Plan of Operation by November 1, 1989. BMPs include: curbing, gutters, downspouts and outlets. These practices were completed by the participant.

3.5 Impacts of Other Federal Programs

The ASCS ACP Cost-Share program has benefitted producers in several ways. Of those farms not approved for a RCWP contract, three now have ACP Long Term Agreements. Several farms remain without approved conservation plans or funds for implementation of BMPs. ACP funds are used annually by some producers for installation of various conservation practices. Practices such as tile drainage systems on poorly drained soils and gutters with downspouts and outlets have been installed to divert fresh water away from farmsteads. Where practical, open ditches have been converted to tile drains. Tile drainage reduces manure runoff from fields and allows manure to be applied earlier and later within the year.

Practices that were installed under programs other than RCWP, such as the ASCS ACP program, Governors Watershed Enhancement Board (GWEB) and with funds from Oregon State Fish and Wildlife are displayed in Table 3-4 beginning on page /?????

3.6 Impacts of State and Local Programs/Regulations

Oregon Statutes require livestock waste water disposal system permits. Liquid manure storage structure construction, (BMP-2 Animal Waste Management System), requires an Oregon Department of Environmental Quality (DEQ) permit. The permit requires a detailed facility description, plot plan, amount of pollutants produced and an estimated facility cost. The RCWP required coordination with the permit requirements.

In 1989, Tillamook County started requiring agricultural building permits. Producers need at least one and possibly three permits before installing solid manure or above ground liquid manure storage facilities and roofing. All producers need authorization for an agricultural building. If proposed structures are located within the flood plain, the County requires a Riverine/Flood Zone and a Construction/Placement permit.

Producers delayed obtaining these state and local permits because of the technical data required and/or form complexity. In order to prevent illegal structure construction or construction delays, the Tillamook County SWCD assists producers with the permit application and process. Although SWCD workload has increased, potential state and local regulation violations were avoided. Tillamook County waived the producers permit fee when the SWCD assisted with the permit applications.

The 1989 legislative session amended aspects of Oregon Statutes concerning Confined Animal Feeding Operation (CAFO). The new law, effective January 1, 1990, is to prevent animal manure from entering state waters. The Oregon Department of Agriculture administers the permit program for DEQ.

The general permit now specifies the maximum number of animals that may be housed at a facility. It is based on the capacity of the operation to contain, treat, hold and dispose of wastes. The confined animal feeding operation may not exceed the maximum number of animals specified by ten percent or 25 animals, whichever is greater.

This new law carries a $500 civil penalty for not having a permit. In addition, a $1,000 annual inspection fee must be paid for three years by operators who have been assessed a civil penalty.

During the fall of 1987, the Board of Tillamook County Commissioners established the Tillamook County Bay Sanitation Technical Advisory Committee(14) to assist the County identify, monitor and address the causes and extent pollution in of the County's rivers and bays. This action helped assure that bays within the County would meet federal standards for shellfish harvesting. Failure to meet the standards would adversely affect the shellfish industry and economy of Tillamook County. Eventually, recreational based tourism related to the rivers and bays would also be affected.

Since the Committee's formation, a number of concerns and issues have been addressed. Tillamook County Health Department entered into an agreement with the Oregon State Health Division to sample Tillamook, Nehalem and Netarts Bays on a regular basis. Tillamook County Health Department collects samples from sewage treatment plant outfalls. Paralytic Shellfish Poisoning (PSP) sampling is also done on a routine basis. Tributary samples are taken on an regular basis by the Tillamook County SWCD.

Sanitary surveys (septic tank evaluations) were conducted using volunteers from the shellfish industry as well as state and local employees from the County Community Development, Health Department, OSU Extension Service, Tillamook County SWCD, Oregon State Health Division and DEQ. Within the Tillamook River Drainage Basin, 386 residential septic tanks were examined. Ten inadequate or failing systems were found.

There were 872 septic tanks examined within the Wilson and Trask Rivers Basins. Thirty-one were identified as inadequate or failing.

On the Miami and Kilches Rivers, 253 septic tank systems were evaluated. Twenty-four were found inadequate or failing. Many of the identified failing septic tank systems have been corrected.

Pollution attributed to fishermen on Tillamook Bay and its tributaries have been examined. Additional chemical toilets were installed, at each boat ramp and various sites around the county. Signs have been installed indicating chemical toilet locations. This activity was in cooperation with the Tillamook County Parks Department, Department of Community Development, Oregon Department of Fish and Wildlife, Tillamook Anglers, and the Northwest Steelheaders Association. In addition the Port of Garibaldi has applied for funds to install a floating rest room on Tillamook Bay.

The Committee has participated in the "Sanitation Management Plan for Commercial Shellfish Harvesting in Tillamook Bay" development. This plan resulted in Tillamook Bay being open to harvesting more frequently than before 1988.

The Committee also provides a forum for the shellfish and dairy industry to discuss issues together and resolve their differences. The Committee became very active in the recent Oregon legislative session to save Oregon's shellfish program. Ballot Measure 5, a state spending reduction measure, resulted in eliminating the shellfish program from the Oregon State Health Division's budget. This budgetary decision threatened Tillamook County's recreational and commercial harvesting. Presently, it appears that the shellfish sanitation program is in Oregon State Health Division's Budget. However, funding is projected at a considerably reduced level.

Department of Bioresource Engineering, Oregon State University in February, 1991, completed the methane plant feasibility study(15)for Tillamook County's Methane Energy and Agricultural Development Committee (MEAD). The objective of this study was to evaluate the potential for using anaerobic digestion to treat dairy manure as an alternative method for further reducing Tillamook County's perceived and potential dairy manure management problems. The study concluded that a methane plant appears encouraging to pursue. This study was funded by the following organizations:

- Tillamook County Public Utility District
- Tillamook County Creamery Association
- Oregon Department of Energy
- Port of Tillamook Bay
- City of Tillamook
- Northwest Oregon Resource and Development (RC&D)

The MEAD committee contracted with a biowaste technology firm to develop a pre-construction plan (16). A $55,000 grant was awarded by the Oregon Department of Energy for this plan. The plan will address a methane plant that will initially process manure from 4,500 to 8,000 livestock or about 30 percent of the manure produced annually. It is scheduled for completion by October 1991.

The plan will identify the following:

- Marketing by products such as biogas for electricity and/or steam generation, dry and liquid fertilizer, soil amendments and heat.
- Producer commitments for manure supplies for the methane plant.
- Facility site plan.
- Identify project financing and operations.
- Permits required and schedules for obtaining them.

In Tillamook County, federal, state and local agencies, dairy industry and local organizations are committed to improving Tillamook Bay's water quality. If the dairy industry intends to expand, alternative manure management programs must be identified and implemented. The methane plant feasibility studies were initiated to move Tillamook's manure manage program toward finding alternative solutions for agricultural related pollution reduction.

3.7 Technical Assistance

3.7.1 Overall Assistance Provided to RCWP Producer Participants

Soil Conservation Service

Primary assistance provided by SCS was planning and application.

- Developed and Revised Conservation Plan of Operations
- Performed Annual Status Reviews
- Provided BMP engineering installation assistance

While there is no secret formula for developing conservation plans, experience provides an approach. Development of an RCWP Conservation Plan in Tillamook involves the following steps:

- An open mind
- Allow a participants to explain their water quality related problems
- Ask participants to consider what their dairy will look like in 15-20 years
- Collect and/or compute data for the following:
    - Cow numbers
    - Soil types
    - Existing storage capacity
    - Waste volumes
    - Bedding requirements
    - Wash water
    - Extent of unroofed manure accumulation areas
    - Acres available for manure spreading
- Identify pollution and/or potential pollution sources
- Prepare cost-estimates with alternatives for correcting problems
- Discuss advantages and disadvantages of early alternative
- Discuss available technical and financial assistance
- Suggest participant obtain estimates from various contractors for BMP installation
- On next visit, discuss participant's decisions - include spouse and family if possible
- Have participant visit farms where practices have been installed
- Develop Conservation Plan of Operations when decisions are made
- With participant's assistance, develop operation and maintenance agreements
- Provide manure spreading guidance to prevent pollution
- Expect modifications - be flexible
- Assist participant with needed design and layout modifications
- Installation for most BMPs required 3 to 5 farm visits

Some examples of technical installation assistance are:

- Design, layout, and practice extent determination
- Foundation investigation for manure storage facilities
- Design report for below ground tanks
- Review non SCS BMP engineering designs
- Inspect waste storage facility site for proper site
- Preparation to insure organic matter, plant material, logs, stumps, buried animals, wood chips, etc. have been removed

- Inspect rock/fill material for quantity, quality and placement to provide an adequate base for construction
- Inspect reinforcement steel placement, spacing, size andquantity for concrete waste storage structures
- Inspect concrete form installations for quality concreteplacement in manure storage facilities
- Inspect and perform required slump tests for concrete quality control
- Inspect completed manure storage facilities to assure all details have been properly completed
- Inspect roof pole excavation holes to assure adequate size and depth
- Inspect pole hole back-fill material
- Inspect pole structure truss placements and attachment to columns or headers to assure adequate structure integrity
- Inspect truss and purlin installation
- Spot check water table control practices for proper grade, depth and bedding
- Measure, calculate and certify BMPs installed

A lack of manure storage facility designs existed prior to this project. Large volume liquid and solid manure storage facility designs were needed. The SCS prepared a number of manure storage facilities designs. The drawings listed below, and marterials lists, are available from: District Conservationist, USDA Soil Conservation Service, 2204 4th Street, Suite B, Tillamook, Oregon, 97141.

Liquid Manure Storage Facility Designs

- 44 foot diameter x 16 foot high above ground concrete tank
  Drawing No. OR-E-504
- 50 foot diameter x 16 foot high above ground concrete tank
  Drawing No. OR-E-507
- 60 foot diameter x 16 foot high above ground concrete tank
  Drawing No. OR-E-509
- 80 foot diameter x 12 foot high above ground concrete tank
  Drawing No. OR-E-516

Solid Manure Storage Facility Designs Pole Supported Truss

- 6 foot storage depth - up to 50 foot building span; variable length
  Drawing No. OR-E-515
- 8 foot storage depth - up to 50 foot building span; variable length
  Drawing No. OR-E-514

Slant Leg Rigid Frame

- 7 foot storage depth - 24 to 40 foot building span; variable length
  Drawing No. OR-E-517

In 1982, five extensive site specific geological foundation investigations for above ground animal waste storage facility installations were conducted (17). These investigations were conducted in areas where potentially weak structured soils existed. The soils were silts, clays and gravels. Soils had varying organic matter content.

This investigation resulted in designs for above ground concrete liquid manure storage facilities for use in the lower bay's weak soil areas.

- 55 foot diameter x 10 foot high above ground concrete tank
  Drawing No. OR-E-524
- •80 foot diameter x 10 foot high above ground concrete tank

Tillamook County Soil and Water Conservation District

- Prioritized RCWP applications
- Approved Participant's Conservation Plan of Operations or Revisions
- Typed Participant's Conservation Plan of Operations and Revisions
- Promoted Project with financial institutions (tours)
- Investigated BMP misuse or mismanagement, and/or water quality complaints
- Assisted participant with required state and county permits
- Developed the brochure *Manure "Management Systems for Tillamook County*

Oregon State Extension Service

Primary assistance provided was information and education. Extension Service was responsible for developing the BMP-15 Fertilizer Management(Waste Utilization) Specification. These were included in all participants' conservation plans of operation.

On numerous occasions, CES provided technical assistance to participant in choosing an animal waste storage structure. They were involved with providing technical assistance on adequate ventilation for waste storage structures and roofs over manure accumulation areas.

3.7.2 Types and Amounts of Assistance Provided to Producers Implementing Each BMP

Table 3-4 is the SCS technical assistance hours needed for planning and implementing each BMP. Time indicated, includes all levels of assistance. Table 3-4 identifies the following:

- Assistance type: Planning, Application and Education.
- Units.
- Technical Assistance hours required per BMP, a planning application unit.
- The number of units planned and/or total BMP units in participants conservation plan of operations.
- Total technical assistance hours required for the BMP planning and application.
- Have used for CPO or BMPs installation as of December 31, 1990.
- Technical assistance hours used in planning and OMP installation as of December,1990
- Planning or BMP units remaining between December 31, 1990 and the end of the Projecton December 31, 1996
- Technical assistance hours required to complete the planning and BMP units by December 1, 1996

3.7.3 Lessons Learned

Well-defined and documented water quality problem are a must. A successful project has achievable water quality improvement goals. Identified critical area associated with the water quality problem is essential. A rating system aided the LCC in defining the critical area and/or potentially critical dairy operations in the Tillamook Project. Adequate BMPs to treat the identified water quality problem must be available. A BMP component system is more effective than a single BMP, which treats only the symptom, in solving an agriculture related water quality problem. The Tillamook Bay Drainage Basin Agricultural Nonpoint Source Pollution Abatement Plan (208) addressed these essential elements.

A successful project requires strong local leadership and the area's agricultural industry's support and involvement. Involved agencies' policies and/or regulations can not create barriers towards project implementation. Agency personnel need excellent day-to-day working relationships.

Best management practices must have farmers' support and commitment, they must be based on site specific needs and farmer preference. Labor, BMP costs, financial incentives and management preference were important factors that influence Tillamook farmer's participation. More efficient management, drier barnyards, less labor, and farmstead esthetics were common non-water quality improvement benefits that led to farmer participation. Participants have taken pride in their farm improvements.

Conservation Plan of Operations (Contracts) need flexibility. Over a ten year period, participants ideas change resulting in contract modifications. Agencies must expect modifications and plan for changes.

Adequate technical, financial, and contractor assistance must be available. Lending institutions also need to understand and support the project.

Contract violations must be resolved at the local level. The County ASC Committee, Soil and Water Conservation Districts, and area's agricultural industry must accept the responsibility to resolve contract violations. Local decisions must have state and national support.

Table 3-1: Project Accomplishments as of December 31, 1990

ITEM	NO.	ACRES	% COMPLETE
DAIRIES IN PROJECT	131	12,190	100%
NON-CRITICAL DAIRIES	22		17%
NON-CRITICAL ACRES		3,470	28%
CRITICAL DAIRIES	109		83%
CRITICAL ACRES		8,720	72%
CRITICAL DAIRIES CONTRACTED	105		96%
CRITICAL ACRES CONTRACTED		8,582	98%
CONTRACTED CRITICAL DAIRIES TREATED TODATE	45		43%
CONTRACTED CRITICAL ACRES TREATED TODATE		4,138	48%
REMAINING CONTRACTED CRITICAL DAIRIES TO TREAT	60		57%
REMAINING CONTRACTED CRITICAL ACRES TO TREAT		4,444	52%

Table 3-2: BMP Planning and Implementation Analysis

BMP 1-a PASTURE AND HAYLAND MANAGEMENT (ACRES)

WATERSHED	RCWP CONTRACTS	NO. OF CONTRACTS WITH BMP	% OF CONTRACTS WITH BMP	TOTAL UNITS PLANNED	INSTALLED UNITS	UNITS REMAINING	% OF UNITS INSTALLED	TOTAL CRITICAL ACRES PLANNED	CRITICAL ACRES TREATED	CRITICAL ACRES REMAINING	% OF CRITICAL ACRES TREATED
MIAMI	0	0	0.0%	0.0	0.0	0.0	0.0%	0.0	0.0	0.0	0.0%
KILCHIS	14	0	0.0%	0.0	0.0	0.0	0.0%	0.0	0.0	0.0	0.0%
TILLAMOOK	37	4	10.8%	237.0	237.0	0.0	100.0%	237.0	237.0	0.0	100.0%
TRASK	28	0	0.0%	0.0	0.0	0.0	0.0%	0.0	0.0	0.0	0.0%
WILSON	19	3	15.8%	151.0	47.0	104.0	31.1%	151.0	47.0	104.0	31.1%
TOTAL	98	7	7.1	388.0	284.0	104.0	73.2%	388.0	284.0	104.0	73.2%

BMP 1-b PASTURE AND HAYLAND PLANTING (ACRES)

WATERSHED	RCWP CONTRACTS	NO. OF CONTRACTS WITH BMP	% OF CONTRACTS WITH BMP	TOTAL UNITS PLANNED	INSTALLED UNITS	UNITS REMAINING	% OF UNITS INSTALLED	TOTAL CRITICAL ACRES PLANNED	CRITICAL ACRES TREATED	CRITICAL ACRES REMAINING	% OF CRITICAL ACRES TREATED
MIAMI*	0	0	0.0%	10.0	10.0	0.0	100.0%	10.0	10.0	0.0	100.0%
KILCHIS	14	0	0.0%	0.0	0.0	0.0	0.0%	0.0	0.0	0.0	0.0%
TILLAMOOK	37	1	2.7%	20.0	20.0	0.0	100.0%	20.0	20.0	0.0	100.0%
TRASK	28	0	0.0%	0.0	0.0	0.0	0.0%	0.0	0.0	0.0	0.0%
WILSON	19	0	0.0%	0.0	0.0	0.0	0.0%	0.0	0.0	0.0	0.0%
TOTAL	98	1	1.0%	30.0	30.0	0.0	100.0%	30.0	30.0	0.0	100.0%

*CONTRACT CANCELLED BY COC AFTER BMP INSTALLED

BMP 2-a-1(DRY) WASTE STORAGE STRUCTURES (CUBIC FEET)

WATERSHED	RCWP CONTRACTS	NO. OF CONTRACTS WITH BMP	% OF CONTRACTS WITH BMP	TOTAL UNITS PLANNED	INSTALLED UNITS	UNITS REMAINING	% OF UNITS INSTALLED	TOTAL CRITICAL ACRES PLANNED	CRITICAL ACRES TREATED	CRITICAL ACRES REMAINING	% OF CRITICAL ACRES TREATED
MIAMI	0	0	0.0%	0.0	0.0	0.0	0.0%	0.0	0.0	0.0	0.0%
KILCHIS	14	14	100.0%	268054.0	260854.0	7200.0	97.3%	33.9	33.9	0.0	100.0%
TILLAMOOK	37	29	78.4%	472922.0	386998.0	85924.0	81.8%	79.7	65.2	14.5	81.8%
TRASK	28	21	75.0%	396391.0	349975.0	46416.0	88.3%	68.2	60.5	7.7	88.7%
WILSON	19	15	78.9%	280330.0	216538.0	63792.0	77.2%	59.6	37.0	22.6	62.1%
TOTAL	98	79	80.6%	1417697.0	1214365.0	203332.0	85.7%	241.4	196.6	44.8	81.4%

BMP 2-a-1(LIQUID) WASTE STORAGE STRUCTURES (CUBIC FT.)

WATERSHED	RCWP CONTRACTS	NO. OF CONTRACTS WITH BMP	% OF CONTRACTS WITH BMP	TOTAL UNITS PLANNED	INSTALLED UNITS	UNITS REMAINING	% OF UNITS INSTALLED	TOTAL CRITICAL ACRES PLANNED	CRITICAL ACRES TREATED	CRITICAL ACRES REMAINING	% OF CRITICAL ACRES TREATED
MIAMI	0	0	0.0%	0.0	0.0	0.0	0.0%	0.0	0.0	0.0	0.0%
KILCHIS	14	9	64.3%	119401.0	87059.0	32342.0	72.9%	18.7	14.7	4.0	78.6%
TILLAMOOK	37	31	83.8%	519844.0	379486.0	140358.0	73.0%	78.5	56.5	22.0	72.0%
TRASK	28	21	75.0%	494543.0	344529.0	150014.0	69.7%	59.2	44.7	14.5	75.5%
WILSON	19	18	94.7%	523961.0	434293.0	89668.0	82.9%	59.2	48.0	11.2	81.1%
TOTAL	98	79	80.6%	1657749.0	1245367.0	412382.0	75.1%	215.6	163.9	51.7	76.0%

BMP 2-a(2a) GUTTERING (FEET)

WATERSHED	RCWP CONTRACTS	NO. OF CONTRACTS WITH BMP	% OF CONTRACTS WITH BMP	TOTAL UNITS PLANNED	INSTALLED UNITS	UNITS REMAINING	% OF UNITS INSTALLED	TOTAL CRITICAL ACRES PLANNED	CRITICAL ACRES TREATED	CRITICAL ACRES REMAINING	% OF CRITICAL ACRES TREATED
MIAMI	0	0	0.0%	0.0	0.0	0.0	0.0%	0.0	0.0	0.0	0.0%
KILCHIS	14	9	64.3%	7566.0	7166.0	400.0	94.7%	19.4	16.7	2.7	86.1%
TILLAMOOK	37	31	83.8%	19917.0	14137.0	5780.0	71.0%	79.8	61.8	18.0	77.4%
TRASK	28	17	60.7%	16646.0	12667.0	3979.0	76.1%	67.2	54.9	12.3	81.7%
WILSON	19	14	73.7%	7282.0	5133.0	2149.0	70.5%	48.9	30.5	18.4	62.4%
TOTAL	98	71	72.4%	51411.0	39103.0	12308.0	76.1%	215.3	163.9	51.4	76.1%

BMP 2a(2-b) ROOFING (SQ.FT.)

WATERSHED	RCWP CONTRACTS	NO. OF CONTRACTS WITH BMP	% OF CONTRACTS WITH BMP	TOTAL UNITS PLANNED	INSTALLED UNITS	UNITS REMAINING	% OF UNITS INSTALLED	TOTAL CRITICAL ACRES PLANNED	CRITICAL ACRES TREATED	CRITICAL ACRES REMAINING	% OF CRITICAL ACRES TREATED
MIAMI	0	0	0.0%	0.0	0.0	0.0	0.0%	0.0	0.0	0.0	0.0%
KILCHIS	14	12	85.7%	75103.0	71503.0	3600.0	95.2%	27.9	27.9	0.0	100.0%
TILLAMOOK	37	30	81.1%	145346.0	127944.0	17402.0	88.0%	96.2	84.7	11.5	88.0%
TRASK	28	26	92.9%	170314.0	149420.0	20894.0	87.7%	84.7	82.5	2.2	97.4%
WILSON	19	18	94.7%	88546.0	56957.0	31589.0	64.3%	60.8	43.3	17.5	71.2%
TOTAL	98	86	87.8%	479309.0	405824.0	73485.0	84.7%	269.6	238.4	31.2	88.4%

BMP 2-a(3) BURIED MAINLINE (FEET)

WATERSHED	RCWP CONTRACTS	NO. OF CONTRACTS WITH BMP	% OF CONTRACTS WITH BMP	TOTAL UNITS PLANNED	INSTALLED UNITS	UNITS REMAINING	% OF UNITS INSTALLED	TOTAL CRITICAL ACRES PLANNED	CRITICAL ACRES TREATED	CRITICAL ACRES REMAINING	% OF CRITICAL ACRES TREATED
MIAMI*	0	0	0.0%	3700.0	3700.0	0.0	100.0%	67.0	67.0	0.0	100.0%
KILCHIS	14	0	0.0%	0.0	0.0	0.0	0.0%	0.0	0.0	0.0	0.0%
TILLAMOOK	37	7	18.9%	17275.0	15775.0	1500.0	91.3%	399.1	362.8	36.3	90.9%
TRASK	28	3	10.7%	7880.0	4480.0	3400.0	56.9%	112.0	69.0	43.0	61.6%
WILSON	19	2	10.5%	3760.0	3760.0	0.0	100.0%	90.0	90.0	0.0	100.0%
TOTAL	98	12	12.2%	32615.0	27715.0	4900.0	85.0%	668.1	588.8	79.3	88.1%

*CONTRACT CANCELLED BY COC AFTER BMP INSTALLED

BMP 2-b WASTE TREATMENT LAGOON (ACRE-FEET)

WATERSHED	RCWP CONTRACTS	NO. OF CONTRACTS WITH BMP	% OF CONTRACTS WITH BMP	TOTAL UNITS PLANNED	INSTALLED UNITS	UNITS REMAINING	% OF UNITS INSTALLED	TOTAL CRITICAL ACRES PLANNED	CRITICAL ACRES TREATED	CRITICAL ACRES REMAINING	% OF CRITICAL ACRES TREATED
MIAMI	0	0	0.0%	0.0	0.0	0.0	0.0%	0.0	0.0	0.0	0.0%
KILCHIS	140	0	0.0%	0.0	0.0	0.0	0.0%	0.0	0.0	0.0	0.0%
TILLAMOOK	37	1	2.7%	21.0	21.0	0.0	100.0%	2.0	2.0	0.0	100.0%
TRASK	28	0	0.0%	0.0	0.0	0.0	0.0%	0.0	0.0	0.0	0.0%
WILSON	19	0	0.0%	0.0	0.0	0.0	0.0%	0.0	0.0	0.0	0.0%
TOTAL	98	1	1.0%	21.0	21.0	0.0	100.0%	2.0	2.0	0.0	100.0%

BMP 2-d-1 CONDUIT (FEET)

WATERSHED	RCWP CONTRACTS	NO. OF CONTRACTS WITH BMP	% OF CONTRACTS WITH BMP	TOTAL UNITS PLANNED	INSTALLED UNITS	UNITS REMAINING	% OF UNITS INSTALLED	TOTAL CRITICAL ACRES PLANNED	CRITICAL ACRES TREATED	CRITICAL ACRES REMAINING	% OF CRITICAL ACRES TREATED
MIAMI	0	0	0.0%	0.0	0.0	0.0	0.0%	0.0	0.0	0.0	0.0%
KILCHIS	14	0	0.0%	0.0	0.0	0.0	0.0%	0.0	0.0	0.0	0.0%
TILLAMOOK	37	1	2.7%	20.0	20.0	0.0	100.0%	4.0	4.0	0.0	100.0%
TRASK	28	1	3.6%	40.0	0.0	40.0	0.0%	8.3	0.0	8.3	0.0%
WILSON	19	0	0.0%	0.0	0.0	0.0	0.0%	0.0	0.0	0.0	0.0%
TOTAL	98	2	2.0%	60.0	20.0	40.0	33.3%	12.3	4.0	8.3	32.5%

BMP 2-d-2 CURBING (FEET)

WATERSHED	RCWP CONTRACTS	NO. OF CONTRACTS WITH BMP	% OF CONTRACTS WITH BMP	TOTAL UNITS PLANNED	INSTALLED UNITS	UNITS REMAINING	% OF UNITS INSTALLED	TOTAL CRITICAL ACRES PLANNED	CRITICAL ACRES TREATED	CRITICAL ACRES REMAINING	% OF CRITICAL ACRES TREATED
MIAMI	0	0	0.0%	0.0	0.0	0.0	0.0%	0.0	0.0	0.0	0.0%
KILCHIS	14	9	64.3%	1068.0	946.0	122.0	88.6%	20.9	16.2	4.7	77.5%
TILLAMOOK	37	23	62.2%	2971.0	1909.0	1062.0	64.3%	61.9	34.4	27.5	55.6%
TRASK	28	19	67.9%	2619.0	2108.0	511.0	80.5%	59.4	53.9	5.5	90.7%
WILSON	19	15	78.9%	1311.0	606.0	705.0	46.2%	48.7	30.7	18.0	63.0%
TOTAL	98	66	67.3%	7969.0	5569.0	2400.0	69.9%	190.9	135.2	55.7	70.8%

BMP 2-e DIKE (FEET)

WATERSHED	RCWP CONTRACTS	NO. OF CONTRACTS WITH BMP	% OF CONTRACTS WITH BMP	TOTAL UNITS PLANNED	INSTALLED UNITS	UNITS REMAINING	% OF UNITS INSTALLED	TOTAL CRITICAL ACRES PLANNED	CRITICAL ACRES TREATED	CRITICAL ACRES REMAINING	% OF CRITICAL ACRES TREATED
MIAMI	0	0	0.0%	0.0	0.0	0.0	0.0%	0.0	0.0	0.0	0.0%
KILCHIS	14	0	0.0%	0.0	0.0	0.0	0.0%	0.0	0.0	0.0	0.0%
TILLAMOOK	37	0	0.0%	0.0	0.0	0.0	0.0%	0.0	0.0	0.0	0.0%
TRASK	28	1	3.6%	45.0	0.0	45.0	0.0%	8.3	0.0	8.3	0.0%
WILSON	19	0	0.0%	0.0	0.0	0.0	0.0%	0.0	0.0	0.0	0.0%
TOTAL	98	1	1.0%	45.0	0.0	45.0	0.0%	8.3	0.0	8.3	0.0%

BMP 2-f DIVERSIONS (FEET)

WATERSHED	RCWP CONTRACTS	NO. OF CONTRACTS WITH BMP	% OF CONTRACTS WITH BMP	TOTAL UNITS PLANNED	INSTALLED UNITS	UNITS REMAINING	% OF UNITS INSTALLED	TOTAL CRITICAL ACRES PLANNED	CRITICAL ACRES TREATED	CRITICAL ACRES REMAINING	% OF CRITICAL ACRES TREATED
MIAMI	0	0	0.0%	0.0	0.0	0.0	0.0%	0.0	0.0	0.0	0.0%
KILCHIS	14	2	14.3%	146.0	146.0	0.0	100.0%	5.0	5.0	0.0	100.0%
TILLAMOOK	37	17	45.9%	2162.0	1587.0	575.0	73.4%	52.9	34.3	18.5	65.0%
TRASK	28	13	46.4%	1727.0	622.0	1105.0	36.0%	33.5	19.2	14.3	57.3%
WILSON	19	12	63.2%	2014.0	1085.0	929.0	53.9%	36.4	24.5	11.9	67.3%
TOTAL	98	44	44.9%	6049.0	3440.0	2609.0	56.9%	127.8	83.1	44.7	65.0%

BMP 2-g SUBSURFACE DRAIN (FEET)

WATERSHED	RCWP CONTRACTS	NO. OF CONTRACTS WITH BMP	% OF CONTRACTS WITH BMP	TOTAL UNITS PLANNED	INSTALLED UNITS	UNITS REMAINING	% OF UNITS INSTALLED	TOTAL CRITICAL ACRES PLANNED	CRITICAL ACRES TREATED	CRITICAL ACRES REMAINING	% OF CRITICAL ACRES TREATED
MIAMI	0	0	0.0%	0.0	0.0	0.0	0.0%	0.0	0.0	0.0	0.0%
KILCHIS	14	0	0.0%	0.0	0.0	0.0	0.0%	0.0	0.0	0.0	0.0%
TILLAMOOK	37	7	18.9%	42935.0	32635.0	10300.0	76.0%	161.1	139.8	21.3	86.8%
TRASK	28	2	7.1%	27170.0	25770.0	1400.0	94.8%	110.1	90.0	20.1	81.7%
WILSON	19	3	15.8%	26195.0	26015.0	180.0	99.3%	61.0	59.0	2.0	96.7%
TOTAL	98	12	12.2%	96300.0	84420.0	11880.0	87.7%	332.2	288.8	43.4	86.9%

BMP 2-h SURFACE DRAIN, MAIN OR LATERAL (FEET)

WATERSHED	RCWP CONTRACTS	NO. OF CONTRACTS WITH BMP	% OF CONTRACTS WITH BMP	TOTAL UNITS PLANNED	INSTALLED UNITS	UNITS REMAINING	% OF UNITS INSTALLED	TOTAL CRITICAL ACRES PLANNED	CRITICAL ACRES TREATED	CRITICAL ACRES REMAINING	% OF CRITICAL ACRES TREATED
MIAMI	0	0	0.0%	0.0	0.0	0.0	0.0%	0.0	0.0	0.0	0.0%
KILCHIS	14	0	0.0%	0.0	0.0	0.0	0.0%	0.0	0.0	0.0	0.0%
TILLAMOOK	37	2	5.4%	7750.0	7750.0	0.0	100.0%	113.0	113.0	0.0	100.0%
TRASK	28	1	3.6%	40.0	0.0	40.0	0.0%	8.3	0.0	8.3	0.0%
WILSON	19	1	5.3%	300.0	300.0	0.0	100.0%	13.0	13.0	0.0	100.0%
TOTAL	98	4	4.1%	8090.0	8050.0	40.0	99.5%	134.3	126.0	8.3	93.8%

BMP 2-1 WASTE MANAGEMENT SYSTEMS (NUMBER)

WATERSHED	RCWP CONTRACTS	NO. OF CONTRACTS WITH BMP	% OF CONTRACTS WITH BMP	TOTAL UNITS PLANNED	INSTALLED UNITS	UNITS REMAINING	% OF UNITS INSTALLED	TOTAL CRITICAL ACRES PLANNED	CRITICAL ACRES TREATED	CRITICAL ACRES REMAINING	% OF CRITICAL ACRES TREATED
MIAMI	0	0	0.0%	0.0	0.0	0.0	0.0%	0.0	0.0	0.0	0.0%
KILCHIS	14	0	0.0%	14.0	10.0	4.0	71.4%	1437.0	792.0	645.0	55.1%
TILLAMOOK	37	0	0.0%	37.0	15.0	22.0	40.5%	3110.0	1244.0	1866.0	40.0%
TRASK	28	0	0.0%	28.0	12.0	16.0	42.9%	3062.0	1432.0	1630.0	46.8%
WILSON	19	0	0.0%	19.0	8.0	11.0	42.1%	1607.0	687.0	920.0	42.8%
TOTAL	98	0	0.0%	98.0	45.0	53.0	45.9%	9216.0	4155.0	5061.0	45.1%

BMP 6-a PIPELINE (FEET)

WATERSHED	RCWP CONTRACTS	NO. OF CONTRACTS WITH BMP	% OF CONTRACTS WITH BMP	TOTAL UNITS PLANNED	INSTALLED UNITS	UNITS REMAINING	% OF UNITS INSTALLED	TOTAL CRITICAL ACRES PLANNED	CRITICAL ACRES TREATED	CRITICAL ACRES REMAINING	% OF CRITICAL ACRES TREATED
MIAMI	0	0	0.0%	0.0	0.0	0.0	0.0%	0.0	0.0	0.0	0.0%
KILCHIS	14	0	0.0%	0.0	0.0	0.0	0.0%	0.0	0.0	0.0	0.0%
TILLAMOOK	37	3	8.1%	4650.0	2150.0	2500.0	46.2%	89.0	32.0	57.0	36.0%
TRASK	28	0	0.0%	0.0	0.0	0.0	0.0%	0.0	0.0	0.0	0.0%
WILSON	19	0	0.0%	0.0	0.0	0.0	0.0%	0.0	0.0	0.0	0.0%
TOTAL	98	3	3.1%	4650.0	2150.0	2500.0	46.2%	89.0	32.0	57.0	36.0%

BMP 6-b TROUGH OR TANK (NUMBER)

WATERSHED	RCWP CONTRACTS	NO. OF CONTRACTS WITH BMP	% OF CONTRACTS WITH BMP	TOTAL UNITS PLANNED	INSTALLED UNITS	UNITS REMAINING	% OF UNITS INSTALLED	TOTAL CRITICAL ACRES PLANNED	CRITICAL ACRES TREATED	CRITICAL ACRES REMAINING	% OF CRITICAL ACRES. TREATED
MIAMI	0	0	0.0%	0.0	0.0	0.0	0.0%	0.0	0.0	0.0	0.0%
KILCHIS	14	0	0.0%	0.0	0.0	0.0	0.0%	0.0	0.0	0.0	0.0%
TILLAMOOK	37	3	8.1%	8.0	3.0	5.0	37.5%	83.0	32.0	51.0	38.6%
TRASK	28	1	3.6%	3.0	0.0	3.0	0.0%	22.0	0.0	22.0	0.0%
WILSON	19	0	0.0%	0.0	0.0	0.0	0.0%	0.0	0.0	0.0	0.0%
TOTAL	98	4	4.1%	11.0	3.0	8.0	27.3%	105.0	32.0	73.0	30.5%

BMP 6-c STOCK TRAILS AND WALKWAYS (FEET)

WATERSHED	RCWP CONTRACTS	NO. OF CONTRACTS WITH BMP	% OF CONTRACTS WITH BMP	TOTAL UNITS PLANNED	INSTALLED UNITS	UNITS REMAINING	% OF UNITS INSTALLED	TOTAL CRITICAL ACRES PLANNED	CRITICAL ACRES TREATED	CRITICAL ACRES REMAINING	% OF CRITICAL ACRES TREATED
MIAMI	0	0	0.0%	0.0	0.0	0.0	0.0%	0.0	0.0	0.0	0.0%
KILCHIS	14	0	0.0%	0.0	0.0	0.0	0.0%	0.0	0.0	0.0	0.0%
TILLAMOOK	37	4	10.8%	259.0	104.0	155.0	40.2%	203.0	48.0	155.0	23.6%
TRASK	28	0	0.0%	0.0	0.0	0.0	0.0%	0.0	0.0	0.0	0.0%
WILSON	19	0	0.0%	0.0	0.0	0.0	0.0%	0.0	0.0	0.0	0.0%
TOTAL	98	4	4.1%	259.0	104.0	155.0	40.2%	203.0	48.0	155.0	23.6%

BMP 10-b FENCING (FEET)

WATERSHED	RCWP CONTRACTS	NO. OF CONTRACTS WITH BMP	% OF CONTRACTS WITH BMP	TOTAL UNITS PLANNED	INSTALLED UNITS	UNITS REMAINING	% OF UNITS INSTALLED	TOTAL CRITICAL ACRES PLANNED	CRITICAL ACRES TREATED	CRITICAL ACRES REMAINING	% OF CRITICAL ACRES TREATED
MIAMI	0	0	0.0%	0.0	0.0	0.0	0.0%	0.0	0.0	0.0	0.0%
KILCHIS	14	1	7.1%	691.0	691.0	0.0	100.0%	2.7	2.7	0.0	100.0%
TILLAMOOK	37	2	5.4%	5182.0	5182.0	0.0	100.0%	70.0	70.0	0.0	100.0%
TRASK	28	1	3.6%	1820.0	0.0	1820.0	0.0%	22.0	0.0	22.0	0.0%
WILSON	19	0	0.0%	0.0	0.0	0.0	0.0%	0.0	0.0	0.0	0.0%
TOTAL	98	4	4.1%	7693.0	5873.0	1820.0	76.3%	94.7	72.7	22.0	76.8%

BMP 12-a STRUCTURE FOR WATER CONTROL (NUMBER)

WATERSHED	RCWP CONTRACTS	NO. OF CONTRACTS WITH BMP	% OF CONTRACTS WITH BMP	TOTAL UNITS PLANNED	INSTALLED UNITS	UNITS REMAINING	% OF UNITS INSTALLED	TOTAL CRITICAL ACRES PLANNED	CRITICAL ACRES TREATED	CRITICAL ACRES REMAINING	% OF CRITICAL ACRES TREATED
MIAMI	0	0	0.0%	0.0	0.0	0.0	0.0%	0.0	0.0	0.0	0.0%
KILCHIS	14	0	0.0%	0.0	0.0	0.0	0.0%	0.0	0.0	0.0	0.0%
TILLAMOOK	37	2	5.4%	2.0	1.0	1.0	50.0%	3.9	1.1	2.8	28.2%
TRASK	28	1	3.6%	1.0	0.0	1.0	0.0%	3.5	0.0	3.5	0.0%
WILSON	19	1	5.3%	1.0	1.0	0.0	100.0%	5.2	5.2	0.0	100.0%
TOTAL	98	4	4.1%	4.0	2.0	2.0	50.0%	12.6	6.3	6.3	50.0%

BMP 15-a WASTE UTILIZATION (ACRES)

WATERSHED	RCWP CONTRACTS	NO. OF CONTRACTS WITH BMP	% OF CONTRACTS WITH BMP	TOTAL UNITS PLANNED	INSTALLED UNITS	UNITS REMAINING	% OF UNITS INSTALLED	TOTAL CRITICAL ACRES PLANNED	CRITICAL ACRES TREATED	CRITICAL ACRES REMAINING	% OF CRITICAL ACRES TREATED
MIAMI	0	0	0.0%	0.0	0.0	0.0	0.0%	0.0	0.0	0.0	0.0%
KILCHIS	14	14	100.0%	1384.0	1322.0	62.0	95.5%	1384.0	1322.0	62.0	95.5%
TILLAMOOK	37	37	100.0%	2897.0	1605.0	1292.0	55.4%	2897.0	1605.0	1292.0	55.4%
TRASK	28	28	100.0%	2808.7	1881.7	927.0	67.0%	2808.7	1881.7	927.0	67.0%
WILSON	19	19	100.0%	1611.0	1040.0	571.0	64.6%	1611.0	1040.0	571.0	64.6%
TOTAL	98	98	100.0%	8700.7	5848.7	2852.0	67.2%	8700.7	5848.7	2852.0	67.2%

Table 3-3: 1981-1990 Summary of BMP Components Installed by Year

BMP COMPONENT	UNIT OF MEASURE	1982	1983	1984	1985	1986	1987	1988	1989	1990
BMP 1 PERMANENT VEGITATIVE COVER										
1-a PAST.MGT.	ACRE	0	163	47	54	8	0	12	0	0
1-b PAST.PLANT.	ACRE	0	10	0	0	8	0	12	0	0
BMP 2 ANIMAL WASTE MANAGEMENT SYSTEMS										
2-a-1 (LIQ)STOR.STR.	NO.	11	8	8	7	7	8	10	4	2
2-a-1 (DRY)STOR.STR.	NO.	15	10	8	7	11	12	6	3	2
2-a(2-a) GUTTERING	FEET	3,728	5,750	4,380	7,392	7,248	3,983	3,383	3,239	0
2-a(2-b) ROOFING	SQ.FT.	56,192	30,722	42,680	49,784	87,707	86,679	18,740	22,197	11,123
2-a(3) MAINLINE	FEET	9,090	0	0	0	3,765	3,080	2,760	2,500	6,520
2-b STORAGE POND	NO.	1	0	0	0	0	0	0	0	0
2-d-1 CONDUIT	FEET	0	0	20	0	0	0	0	0	0
2-d-2 CURBING	FEET	393	4,042	80	73	845	1,374	660	502	0
2-e DIKE	FEET	0	0	0	0	0	0	0	0	0
2-f DIVERSION	FEET	229	538	244	405	115	611	352	486	460
2-g SUBSUR.DRAIN	ACRE	199	30	16	0	19	24.8	0	0	0
2-h SURFACE DRAIN	ACRE	9	19	86	9	0	0	3	0	0
2-i WASTE MGT.SYS.	NO.	1	4	4	3	2	5	15	6	5
BMP 6 GRAZING LAND PROTECTION SYSTEMS										
6-a PIPELINE	FEET	100	0	2,050	0	0	0	0	0	0
6-b TROUGH OR TANK	NO.	0	1	2	0	0	0	0	0	0
6-c TRAILS/WALKWAYS	FEET	24	0	0	0	50	30	0	0	0
BMP 10 STREAM PROTECTION										
10-b FENCING	FEET	0	0	2,220	0	1,550	0	691	0	1,412
BMP 12 SEDIMENT RETENTION, EROSION, OR CONTROL STRUCTURES										
12-a STR./ CONT.	NO.	0	0	0	1	0	1	0	0	0
BMP 15 FERTILIZER MANAGEMENT										
15-a WASTE UTIL.	ACRE	0	695	477	588	274	427	1,276	1,390.7	721

Table 3-4: Practices Installed Under Programs Other Than RCWP

BMP 1-a : PASTURE AND HAYLAND MANAGEMENT (ACRES)

WATERSHED	NO. OF FARMS WITH BMP	INSTALLED UNITS	CRITICAL ACRES TREATED
MIAMI	0	0.0	0.0
KILCHIS	0	0.0	0.0
TILLAMOOK	2	39.0	39.0
TRASK	2	48.5	48.5
WILSON	1	5.0	5.0
TOTAL	8	91.0	91.0

BMP 1-b PASTURE AND HAYLAND PLANTING (ACRES)

WATERSHED	NO. OF FARMS WITH BMP	INSTALLED UNITS	CRITICAL ACRES TREATED
MIAMI	0	0.0	0.0
KILCHIS	0	0.0	0.0
TILLAMOOK	3	26.0	26.0
TRASK	4	60.0	60.0
WILSON	1	5.0	5.0
TOTAL	8	91.0	91.0

BMP 2-a-1: WASTE STORAGE STRUCTURES (DRY) (CUBIC FEET)

WATERSHED	NO. OF FARMS WITH BMP	INSTALLED UNITS	CRITICAL ACRES TREATED
MIAMI	0	0.0	0.0
KILCHIS	0	0.0	0.0
TILLAMOOK	1	10,080.0	5.0
TRASK	2	16,411.0	2.0
WILSON	0	0.0	0.0
TOTAL	3	26,491.0	7.0

BMP 2-a-1: WASTE STORAGE STRUCTURE (LIQUID) (CUBIC FEET)

WATERSHED	NO. OF FARMS WITH BMP	INSTALLED UNITS	CRITICAL ACRES TREATED
MIAMI	1	18,096.0	3.0
KILCHIS	0	0.0	0.0
TILLAMOOK	3	10,857.0	6.0
TRASK	4	20,638.0	8.0
WILSON	0	0.0	0.0
TOTAL	8	49,591.0	17.0

BMP 2-a(2a): GUTTERING (FEET)

WATERSHED	NO. OF FARMS WITH BMP	INSTALLED UNITS	CRITICAL ACRES TREATED
MIAMI	0	0.0	0.0
KILCHIS	1	1,105.0	2.0
TILLAMOOK	6	4,843.0	14.5
TRASK	11	12,152.0	30.2
WILSON	3	1,631.0	7.7
TOTAL	21	19,731.0	54.4

BMP 2-a(2-b) : ROOFING (SQ.FEET)

WATERSHED	NO. OF FARMS WITH BMP	INSTALLED UNITS	CRITICAL ACRES TREATED
MIAMI	0	0.0	0.0
KILCHIS	0	0.0	0.0
TILLAMOOK	1	5,298.0	1.0
TRASK	3	8,400.0	8.0
WILSON	1	1,292.0	1.3
TOTAL	5	14,990.0	10.3

BMP 2-a(3): BURIED MAINLINE (FEET)

WATERSHED	NO. OF FARMS WITH BMP	INSTALLED UNITS	CRITICAL ACRES TREATED
MIAMI	0	0.0	0.0
KILCHIS	0	0.0	0.0
TILLAMOOK	0	0.0	0.0
TRASK	1	3,000.0	137.0
WILSON	0	0.0	0.0
TOTAL	1	3,000.0	137.0

BMP 2-d-1: CONDUIT (FEET)

WATERSHED	NO. OF FARMS WITH BMP	INSTALLED UNITS	CRITICAL ACRES TREATED
MIAMI	0	0.0	0.0
KILCHIS	0	0.0	0.0
TILLAMOOK	1	260.0	2.0
TRASK	0	0.0	0.0
WILSON	1	342.0	2.0
TOTAL	2	602.0	4.0

BMP 2-d-2: CURBING (FEET)

WATERSHED	NO. OF FARMS WITH BMP	INSTALLED UNITS	CRITICAL ACRES TREATED
MIAMI	0	0.0	0.0
KILCHIS	0	0.0	0.0
TILLAMOOK	1	96.0	2.0
TRASK	2	283.0	6.0
WILSON	0	0.0	0.0
TOTAL	3	379.0	8.0

BMP 2-f : DIVERSIONS (FEET)

WATERSHED	NO. OF FARMS WITH BMP	INSTALLED UNITS	CRITICAL ACRES TREATED
MIAMI	1	48.0	3.0
KILCHIS	0	0.0	0.0
TILLAMOOK	0	0.0	0.0
TRASK	0	0.0	0.0
WILSON	0	0.0	0.0
TOTAL	1	48.0	3.0

BMP 2-g : SUBSURFACE DRAIN (FEET)

WATERSHED	NO. OF FARMS WITH BMP	INSTALLED UNITS	CRITICAL ACRES TREATED
MIAMI	0	0.0	0.0
KILCHIS	3	24,112.0	108.9
TILLAMOOK	24	256,698.0	779.2
TRASK	14	129,453.0	449.2
WILSON	6	24,907.0	90.6
TOTAL	47	435,170.0	1427.9

BMP 2-h SURFACE DRAIN, MAIN OR LATERAL (FEET)

WATERSHED	NO. OF FARMS WITH BMP	INSTALLED UNITS	CRITICAL ACRES TREATED
MIAMI	0	0.0	0.0
KILCHIS	0	0.0	0.0
TILLAMOOK	2	5,608.0	61.8
TRASK	1	385.0	4.3
WILSON	0	0.0	0.0
TOTAL	3	5,993.0	66.1

BMP 2-i: WASTE MANAGEMENT SYSTEMS (NUMBER)

WATERSHED	NO. OF FARMS WITH BMP	INSTALLED UNITS	CRITICAL ACRES TREATED
MIAMI	0	0.0	0.0
KILCHIS	0	0.0	0.0
TILLAMOOK	1	1.0	42.0
TRASK	1	1.0	76.0
WILSON	0	0.0	0.0
TOTAL	2	2.0	118.0

BMP 6-c: STOCK TRAILS OR WALKWAYS (FEET)

WATERSHED	NO. OF FARMS WITH BMP	INSTALLED UNITS	CRITICAL ACRES TREATED
MIAMI	1	38.0	7.1
KILCHIS	0	0.0	0.0
TILLAMOOK	1	30.0	36.3
TRASK	0	0.0	0.0
WILSON	0	0.0	0.0
TOTAL	2	68.0	43.4

BMP 10-a: STREAMBANK PROTECTION (FEET)

WATERSHED	NO. OF FARMS WITH BMP	INSTALLED UNITS	CRITICAL ACRES TREATED
MIAMI	3	1,086.0	6.2
KILCHIS	0	0.0	0.0
TILLAMOOK	1	335.0	2.0
TRASK	1	165.0	19.0
WILSON	1	830.0	12.0
TOTAL	6	2,416.0	39.2

BMP 10-b: FENCING (FEET)

WATERSHED	NO. OF FARMS WITH BMP	INSTALLED UNITS	CRITICAL ACRES TREATED
MIAMI	1	3,193.0	36.1
KILCHIS	0	0.0	0.0
TILLAMOOK	3	8,088.0	115.0
TRASK	0	0.0	0.0
WILSON	0	0.0	0.0
TOTAL	4	11,281.0	151.0

BMP 11-a: CRITICAL AREA PLANTING (ACRES)

WATERSHED	NO. OF FARMS WITH BMP	INSTALLED UNITS	CRITICAL ACRES TREATED
MIAMI	2	2.0	2.0
KILCHIS	0	0.0	0.0
TILLAMOOK	4	4.0	4.0
TRASK	1	1.0	1.0
WILSON	1	1.0	1.0
TOTAL	8	8.0	8.0

BMP 12-a: STRUCTURES FOR WATER CONTROL (NUMBER)

WATERSHED	NO. OF FARMS WITH BMP	INSTALLED UNITS	CRITICAL ACRES TREATED
MIAMI	0	0.0	0.0
KILCHIS	2	2.0	89.0
TILLAMOOK	1	1.0	100.0
TRASK	0	0.0	0.0
WILSON	0	0.0	0.0
TOTAL	3	3.0	189.0

BMP 15-a: WASTE UTILIZATION (ACRES)

WATERSHED	NO. OF FARMS WITH BMP	INSTALLED UNITS	CRITICAL ACRES TREATED
MIAMI	1	94.0	94.0
KILCHIS	0	0.0	0.0
TILLAMOOK	1	42.0	42.0
TRASK	1	76.0	76.0
WILSON	0	0.0	0.0
TOTAL	3	212.0	212.0

Table 3-5: Tillamook Bay RCWP SCS Technical Assistance (June5, 1981 to December 31, 1996)

	ASSISTANCE TYPE	UNIT	HOUR FACTOR	UNITS PLANNED	TOTAL HOURS	UNITS INSTALLED	HOURS USED	UNITS REMAINING	HOURS NEEDED
WATER QUALITY PLANS:									
Development	P	NO.	40.0	101.0	4040	101.0	4040	0.0	0
Revisions	P	NO.	4.0	195.0	780	145.0	580	50.0	200
Annual Status Reviews	P	NO.	2.0	962.0	1920	710.0	1420	252.0	500
BMP CODES:									
1-a PAST.MAN.	A/E	ACRES	0.100	388.0	40	284.0	30	104.0	10
1-b PAST.PLANT.	A	ACRES	0.140	30.0	10	30.0	10	0.0	0
2-a-1(DRY)STOR.	A	NO.	104.0	91.0	9460	74.0	7700	17.0	1760
2-a-1(LIQUID)STOR.	A	NO.	141.3	90.0	12710	63.0	8900	27.0	3810
2-a(2-a)GUTTER.	A	FEET	0.007	51411.0	360	39103.0	270	12308.0	90
2-a(2-b)ROOF.	A	NO.	28.00	175.0	4900	137.0	3840	38.0	1060
2-a(3)BUR.MAIN.	A	FEET	0.020	32615.0	650	27715.0	550	4900.0	100
2-b WASTE.LAGOON	A	NO.	306.0	1.0	310	1.0	310	0.0	0
2-d-1 CONDUIT	A	FEET	0.040	60.0	20	20.0	10	40.0	10
2-d-2 CURBING	A	FEET	0.025	7969.0	200	5569.0	140	2400.0	60
2-e DIKE	A	FEET	3.000	45.0	140	0.0	0	45.0	140
2-f DIVERSIONS	A	NO.	2.500	64.0	160	37.0	90	27.0	70
2-g SUB.DRAIN	A	ACRES	1.000	332.0	330	288.0	290	44.0	40
2-h SUR.DRAIN	A	FEET	0.020	8090.0	160	8050.0	160	40.0	0
2-i WASTE.SYS.	A/E	NO.	0.890	0.0	0	0.0	0	0.0	0
6-a PIPELINE	A	FEET	0.004	4650.0	2	2150.0	10	2500.0	10
6-b TROUGH/TANK	A	NO.	2.500	11.0	30	8.0	20	3.0	10
6-c TRAILS/WALK.	A	NO.	15.00	5.0	80	3.0	50	2.0	30
10-b FENCING	A	FEET	0.007	7693.0	50	5873.0	40	1820.0	10
12-a STRU.CONT.	A	NO.	30.00	4.0	120	2.0	60	2.0	60
15-a WASTE UTIL.	A/E	ACRES	0.500	8700.7	4350	5848.7	2920	2852.0	1430
TOTAL					40,840		31,440		9,400

P = PLANNING A = APPLICATION E = EDUCATION

4.0 Project Information and Education Activities

4.1 Findings and Recommendations

Findings

- The Tillamook Project has become "the place to go" for information on animal waste management.
- Project's publicity has resulted in other states either visiting the project or requesting project information.
- RCWP has been utilized by the ASCS Water Quality Special Project Counties to develop their project requests and programs.
- Tours for financial lending institution representatives are useful in helping participants obtain their share of the BMP installation expenses.

4.2 Cooperative Extension Service Activities

Cooperative Extension Service (CES) serves as the lead agency for the Tillamook RCWP in developing and implementing information and education (I&E) programs to inform both participants and the public about this water quality program. Specific strategies were:

- To create an awareness and understanding of the RCWP among participants.
- To inform the general public about RCWP by stressing positive aspects of the project including financial investments required of participants.

Table 4-1 identifies project I&E goals and accomplishments as of December 31, 1990.

Table 4-1: RCWP Information and Education Accomplishment (1981 thru 1990)

I&E ACTIVITY	PROJECT GOAL	ACHIEVEMENTS SINCE PROJECT APPROVAL	CUMULATIVE PERCENT COMPLETED
MAJOR TOURS OF PROJECT FOR NEWS MEDIA, AGENCY HEADS, POLITICAL LEADERS, ETC.	40	39	98%
DEVELOP PROJECT SLIDE SERIES	9	8	89%
PROJECT DISPLAY BOOTH	15	13	87%
MEETING W/PROGRAM PARTICIPANTS	3	1	33%
TALKS TO CIVIC GROUPS	48	37	77%
INTERAGENCY MEETINGS TO EVALUATE PROGRESS AND COORDINATE BMP IMPLEMENTATION WITH WATER QUALITY MONITORING PROGRAM	20	19	95%

ASCS, SCS and the Tillamook County SWCD assisted CES with the I&E program. Local media outlets were the Headlight-Herald newspaper and KTIL Radio Station. During 1982, CES developed nine five minute RCWP radio spot announcements that were aired on the local radio station informing listeners about the RCWP. The Tillamook County Creamery Association's newsletter was also used to keep producers informed about the project.

Additional news media sources were:

- The Oregonian
- Capital Press (Serves Oregon, Washington, Idaho and Northern California)
- Daily Journal of Commerce
- OCZMA Newsletter (Oregon Coastal Zone Management)
- The Dairymen
- Hoard's Dairyman
- DairyLife Northwest
- Oregon Farmer-Stockman

CES's I&E program was hampered late in 1983 when the County Extension Service's budget was disapproved by Tillamook County. The county agent retirement during this time further affecting the I&E program.

The 1984 I&E Work Plan's major objectives were:

- Continue to create an awareness and understanding of the RCWP among participants.

- Continue to create a public awareness to a wide variety of non-dariy groups of the RCWP by stressing positive aspects of the project including financial investments required of participants.

- In cooperation with SCS, continue to assist the efforts to develop and evaluate RCWP plans for meeting the project's objectives. This includes one-on-one farm visits and group meetings.

- Maintain a mailing list which would be used to inform agricultural producers about the water quality program and BMPs.

- Develop additional publications to assist program participants implement and manage BMPs and manure management systems.

In 1985, CES identified two producer groups needing assistance:

- Producers who had requested RCWP Long-Term Agreements and needed information to assist in selecting a waste management system. Information was needed by producers for selecting BMPs based on water quality objectives, initial and long term costs, labor requirements, commercial fertilizer requirements and long term management commitments. To accomplish this, CES conducted visits of farms having various systems installed, developed publications, and held individual and group meetings to assist participants.

- Producers who had not requested RCWP Long Term Agreements. I&E program required a strong awareness delivery approach. Producers needed to understand how the program would benefit them. Individual farm visits were used to reach this group.

CES farm visits with participants caused major attitude changes of some producers. These changes were noted as improved manure utilization and labor requirements. Information and education programs on proper and optimum use of manure were working.

Another important CES I&E activity has been coordinating and arranging RCWP tours for financial institution representatives. These tours are directed at educating lending institutions on the importance of loans for reducing agricultural related pollution in Tillamook Bay.

In 1985, CES identified a need to obtain local data regarding nitrogen uptake. The Tillamook Project is a surface water pollution abatement program, but National and State direction has shifted to ground water contamination by livestock operations. This shift created a need for evaluating the Tillamook Project's impact on ground water.

The CES 1988 Work Plan added a "Nitrogen Uptake Study"(18). The study is designed to measure nitrogen movement through six various pathways:

- Volatilization
- Denitrification
- Runoff
- Deep Leaching
- Plant Uptake
- Additions to the Soil System

This study will determine the amount of manure producers can apply to pastures without polluting ground water. Research plots are located in Tillamook County and on the Oregon State University dairy farm in Corvallis, Oregon. Nitrogen contamination is the major pollution concern.

When this study is completed in late 1991, localized data will be used to protect ground water by revising animal waste utilization specifications for Tillamook County. Also, improved manure and pasture management strategies will be made available to decision makers and producers.

4.3 Agricultural Stabilization and Conservation Service Activities

ASCS had the overall administrative leadership in the Tillamook RCWP. Information activities were primarily informing area producers about RCWP. Letters were initially sent to all prospective participants explaining the program. The ASCS newsletter was used extensively to keep project area producers informed about RCWP progress. ASCS was responsible for determining program eligibility and explaining the program to participants.

Activities included establishing working agreements for program assistance with Federal, State and Local Agencies and others. Information activities included developing and carrying out an annual plan of work. ASCS is responsible for annual reports.

4.4 Soil Conservation Service Activities

Activities included the development of a slide presentation. This presentation has been used to inform the following groups about the RCWP:

- Kiwanis • Lions • Farm Bureau
- Other Oregon SWCDs
- DEQ Policy Advisory Committee
- State Board of Agriculture
- Pacific Coast Oyster Growers' Association
- South Puget Sound Land Use Planner's Meeting

4.5 Water Quality Agencies' Activities

During the 208 Plan development, Oregon Department of Environmental Quality (DEQ) served on the Tillamook Bay Water Quality Committee. Water quality data and interpretations were presented to the committee on a regular basis. DEQ developed a slide presentation that discussed identified pollution problems and sources. This presentation has been shown to various agencies and organizations; LCC, SCS, Tillamook County SWCD, ASC County Committee and Farm Bureau. The objective was to inform the community of Tillamook Bay pollution problems.

DEQ kept their Policy Advisory Committee and the Environmental Quality Commission informed about the Tillamook Project. DEQ representatives have spoken at various water quality workshops, such as the North America Lake Management Society meeting and at annual RCWP meetings.

DEQ is also an advisor to the Tillamook Bays Sanitation Committee. They are responsible for keeping the committee informed on monitoring program results and conclusions.

4.6 LCC/SCC Activities

In 1984, the SCC prepared a project pictorial notebook for the National Coordinating Committee. These photographs and narratives were designed to familiarize NCC members with the Tillamook Bay project problems and solutions.

4.7 Inter-agency Activities

With assistance from Oregon Department of Agriculture, Natural Resource Division, Tillamook County SWCD developed a RCWP display. This display was set up at the Tillamook County Creamery' visitors center, local banks and County Fair to inform the public about RCWP. It has also been displayed at the following:

- Tillamook Chamber of Commerce Meeting
- Oregon Association of Conservation District's Annual Meeting
- Pacific Region National Association of Conservation District's Annual Meeting
- North American Lake Management Society's Meeting in Kansas City

The SWCD also developed the brochure entitled " Manure Management Systems for Tillamook County". This brochure has been distributed through out Oregon and is used by the DEQ field office to provide a variety of new ideas for dairy producers who have animal waste management problems.

KGW TV, Channel 8 in Portland, Oregon worked with the SWCD in developing an RCWP spot for the July 17, 1985 broadcast. The SWCD has also coordinated various Tillamook RCWP tours for ASCS County Committees and SWCDs from Oregon, Washington and California.

In 1986, the Tillamook County SWCD coordinated the Farm-City Day sponsored by the Tillamook Chamber of Commerce and Tillamook County Farm Bureau. The theme was the Tillamook RCWP.

During 1990, the SWCD hosted Oregon's Coordinated Resource Management Program Committee's Annual Meeting. A tour included visits to various RCWP farms for viewing and discussing BMP installations.

Tillamook County SWCD's Annual Reports are used to keep the public and RCWP participants informed on the RCWP progress. These reports are included as supplements to the Headlight-Head, the local newspaper.

4.8 Public Involvement

Public participation in the Tillamook project began in 1979 during the 208 planning process undertaken by the Tillamook County Soil and Water Conservation District (SWCD). A water quality committee was established representing the following groups:

- Private Citizens
- Public Interests
- Public Officials
- Economic Interests

The purpose of the water quality committee was to assist and advise the Tillamook County SWCD with development of the Tillamook Bay 208 Plan. The Water Quality Committee identified agricultural non-point source pollution problems, developed best management practices (BMPs), and implemented an agricultural pollution abatement program during the 208 planning process.

The initial Tillamook RCWP Public Participation Plan involved a Local Coordinating Committee (LCC). All interested agencies and farm organizations in Tillamook County were appointed to the LCC. They met immediately after the project's approval and developed the following strategy:

- To inform all news media, farm and civic organizations about RCWP objectives.

- To inform contractors about RCWP. A contractors workshop was held to discuss the RCWP.

- To make arrangements with Oregon State University to utilize a computer program developed to evaluate various options available to a producer for solving animal waste pollution problems. The objective was to identify the most cost effective practices that would solve the pollution problem.

- To develop a rating system to prioritize RCWP applications.

4.9 List of Published General Information Material

- 1983 Yearbook of Agriculture, United States Department of Agriculture, *East and West, Animal Waste Cleanup Pays*, by E. Alan Cassell and John Van Calcar

- Environmental Protection Agency Journal, July-August 1985, Volume II, Number 6, *Helping the Oyster Get Along with Cows*, by Bob Jacobson

- Journal of Soil and Water Conservation, May-June 1989, Volume 44, Number 3, *The Economy of Rain and the Tillamook Imperative*, by Charles Little

- Agriculture Digest, September, 1985, featured the paper presented by John A. Jackson, Oregon Department of Environmental Quality, at the Nonpoint Source Pollution Conference held in May 1985 in Kansas City

- Extension Review, United States Department of Agriculture,Spring 1983. *Bay Cleanup Boosts Economy*, by Jim Bottom, Oregon State University

- EPA Publication, 1988, *A Comprehensive Source Control Program for Protecting Shellfish Water*

- *Calculating the Fertilizer Value of Manure from Livestock Operations*, Extension Circular 1094, January 1982. Oregon State University

- *Selecting a Dairy Waste Management System for the Oregon Coast*, September 1982. Oregon State University

- *Managing Storage Facilities for Livestock Manure*, Extension Circular 11081, October 1982. Oregon State University

- *Manure Management Systems For Tillamook County*, May 1984. Tillamook County Soil and Water Conservation District

5.0 Institutional Relationships and Economics

5.1 Findings and Recommendations

Findings

- National RCWP application guidelines were not well defined when the program was first announced.
- Extensive water quality impairment background data was required to gain national level project approval.
- Tillamook Bay Project application had water quality impairment data because EPA funded the 1981 Tillamook Bay Drainage Basin 208 Plan.
- Cooperation between federal agencies at the state and local levels was outstanding and productive in the Tillamook Bay RCWP.
- Project communication at the national level was lacking. At the national level, ASCS's fund transfer to cooperating agencies was not widely known or very well thought out in advance of program.
- In the Tillamook Project, a computer was effective in planning, implementation, administration and workload analysis functions.
- The Tillamook Project created a conservation planning workload during the first five years. Annual status reviews also were required during this heavy planning workload. Some participants annual status reviews were not performed due to inadequate staffing.
- BMP components must be considered when developing realistic BMP average costs.
- Roofing manure accumulation areas in a 90 inch annual rainfall area is more cost-effective than collecting and storing contaminated rainwater.
- Tile drainage systems decrease manure storage requirements for those operations having large acreage of poorly drained soils.
- An installed manure management system decreases labor requirements, improves herd health, improves manure utilization and decreases commercial fertilizer usage.
- Manure nutrient values saved will offset manure management system implementation costs.

Recommendations

- Future programs should be announced in advanced with clear project application guidelines.

- At the national level, a procedure for transferring project funds to cooperating agencies is needed. This will assure smooth and efficient program administration at the state level.

- For future projects, it is recommended that agencies responsible for administration, planning and implementation and water quality data, have computer networking capabilities. This would assist with the over all project management, reports, program redirection, and earlier project evaluations.

- For future projects requiring a large planning workload, consideration should be given to permitting annual status reviews for ten year contracts to start three years following the plan development except where substantial contract completion has occurred.

5.2 Institutional Arrangements

A Local Coordinating Committee (LCC) was organized. The Committee's duties were to ensure that a process existed and actions were taken to carry out the approved project. The committee was responsible for an adequate level of public participation in implementing the project. Coordination activities included developing the plan of work for carrying out the project. The committee developed criteria for prioritizing producer applications for water quality plans and assisted in monitoring a project plan. Three subcommittees were formed to direct the information and education, technical assistance and the monitoring activities.

The Tillamook RCWP LCC included the following agencies or organization:

- Tillamook County Agriculture Stabilization and Conservation Committee (COC)
- USDA Agriculture Stabilization and Conservation Service (ASCS)
- USDA Soil Conservation Service (SCS)
- USDA Farmers Home Administration (FmHa)
- Oregon Department of Forestry (ODF)
- Cooperative Extension Service (CES)
- Tillamook County Creamery Association (TCCA)
- Tillamook County Soil and Water Conservation District (SWCD)
- Tillamook County Farm Bureau
- Oregon Department of Environmental Quality (DEQ)
- Oregon Department of Fish and Wildlife (ODF&W)
- McMinnville Farmers Creamery Association
- Tillamook Bay Water Quality Committee

Responsibilities of each agency and organization were as follows:

Tillamook County Agricultural Stabilization and Conservation Committee (COC)

- The COC was responsible for administration of the RCWP at the local level. A COC member served as the Local Coordinating Committee chairperson.

- Provided over all administrative support to the RCWP project through the County Executive Director (CED) included: accepting RCWP applications, administering contracts, making payment and preparing reports.
- Recommend BMP approvals.
- Jointly with the SWCD, determined the priority for technical assistance among individual applicants for water quality plans using the criteria developed by the LCC.
- Serves on the Monitoring Committee.

Agricultural Stabilization and Conservation Service

- Chair the LCC and through the COC, be responsible for developing and administering RCWP.
- Provide administrative support for the project by:
  - Accepting applications.
  - Preparing and approving contracts.
  - Carrying out fund control.
  - Issuing cost-share payments.
  - Administering contracts and payments.
  - Providing compliance oversight.
  - Maintaining records and developing reports.
- Enter into a working agreement with the Tillamook County SWCD and others as needed for RCWP assistance.
- Through the COC, work with landowners and operators in project area to encourage participation for the installation of needed BMPs.
- Develop cost-share rates for installing BMPs. Prepare COC recommendations for cost-share rates and adjustments for STC approval.
- Assure that the RCWP is coordinated with other related conservation programs.
- Responsible for developing, carrying out, and annually reviewing the plan of work for the project.
- With the Monitoring Committee, be responsible for the overall evaluation of the project's water quality improvement.

Soil Conservation Service

- Chair the Technical Coordinating Committee.
- Provide BMP technical assistance.
- Develop, revise and certify participants' water quality plans.
- Conduct annual status reviews with the participants.
- Assist COC in preparing RCWP Annual Reports.
- Assist the Information and Education Committee.
- Serve as an advisor to the Monitoring Committee.

Tillamook County Soil and Water Conservation District

- Promote the RCWP.
- Jointly with the COC, determine priority technical assistance needs among applicants for water quality plans using criteria developed by the LCC.
- Approve applicants' water quality plans and revisions.
- Serves as a member on the Technical Coordination and Monitoring Committees.

Cooperative Extension Service

- Chair the Information and Education Committee.
- Develop, implement and coordinate informational and educational materials and activities including media releases and tours.
- Provide BMP technical assistance.
- Serve as an advisor to the Monitoring Committee.

Farmers Home Administration

- Participate on the LCC.
- Provide assistance and coordinate local FmHa loan programs with RCWP.
- Serve as an advisory to the Monitoring Committee.

Oregon Department of Forestry

- Participate on the LCC.
- Provide coordination on stream corridor management and in forested areas assure compliance with Oregon Forest Practice Act.
- Serve as and an advisor to the Monitoring Committee.

Oregon Department of Environmental Quality

- Chair the Monitoring Committee.
- Serve as a member of the Technical Coordinating and Information and Education Committees.
- Provide leadership in developing and carrying out an adequate monitoring program in cooperation with the LCC.
- Assist the COC in coordination with other water quality programs in the RCWP area.

Tillamook County Creamery Associaton

- Participate on the LCC.
- Serve as member of the Monitoring Committee.
- Provide an industry point-of-view to the project. Assist with informing producers about the RCWP.

Tillamook Bay Water Quality Committee

- Participate on the LCC.
- Serve as a member of the Monitoring Committee. Select two private citizens to serve on this committee.
- Provide coordination between the Tillamook Bay Drainage Basin Agricultural Non-point Source Pollution Abatement Plan and the RCWP.

Farm Bureau

- Participate on the LCC.
- Serve as a member of the Monitoring Committee.
- Provide coordination between local farm organizations and the LCC.

Oregon Department of Fish and Wildlife

- Participate on the LCC.
- Serve as a member of the Technical Coordination and the Monitoring Committees.
- Coordinate policies of the Oregon Department of Fish and Wildlife with installation of BMPs in the RCWP.

McMinnville Farmer Creamery Association

- Participate on the LCC.
- Serve as a member of the Monitoring Committee.
- Provide an industry point-of-view to the project. Assist with informing producers about the RCWP.

5.2.1 Project Adminstration

As the lead agency, ASCS responsible is for problem solving and making final Tillamook project decisions. However, efforts were made to involve all agencies with these decisions. When necessary, participating agencies would contact their respective state or national offices for guidance or assistance in resolving concerns. This required some "give and take" from participating agencies. As the Tillamook project progressed, this process became easier.

5.2.2 L CC/SCC Coordination

A diverse group of agencies and organizations participated in the Tillamook Bay Project. All groups and organizations had project responsibilities with the LCC being the focal point. Subcommittees directed the LCC's activities and assistance in decision making.

The State Coordinating Committee (SCC) provided assistance to the LCC as needed. The SCC and LCC provided annual review opportunities for solving project related concerns for direction.

Cooperative efforts from the ASC County Committee, Tillamook County SWCD, Tillamook County Creamery Association and the local Cooperative Extension Service agent, resulted in an extremely high percentage of producer interest and participation. Some reluctant critical area producers were visited several times by members of the group. Visits were both individually and as a committee. The purpose was to discuss the RCWP with producers and convince them the program would benefit their operation. This resulted in critical dairy operations being funded under the RCWP. Without this strong local involvement, the Tillamook Project would not have been as successful.

5.2.3 BMP Maintenance Tracking

In the beginning, it was recognized installed BMPs must be managed and maintained if the project was to successfully reduce agricultural related pollution. Animal waste system management and maintenance are long term commitments.

RCWP contracts require maintenance of cost-shared BMPs for the normal life span of the BMPs even though the contract may have expired. Lack of BMP maintenance may result in the participant refunding cost-share payments to ASCS. The contract and conservation plan of operation (CPO) outlined the participant's obligation in managing and maintaining installed BMPs.

Annual status reviews are the primary method for BMP maintenance tracking. These reviews are SCS's responsibility. During the first five years, water quality plan development workload was high for the Tillamook SCS field office staff. Consequently, some annual status reviews were not completed. Since the completion of the RCWP water quality plans, annual status reviews are being completed. ASCS has ongoing BMP maintenance spot check requirements to ensure BMPs are maintained and managed properly.

COC and SWCD letters have been effective in correcting maintenance related problems. The TCCA field representative has also been involved with producers in correcting reported deficiencies.

Presently, the Tillamook project maintenance tracking is working. Participation by various organizations is a key factor in assuring success of the RCWP. These organizations realize this is a long term project with BMP maintenance and management requiring long term commitments.

5.2.4. Assesment of Assistance Provided by Federal Agencies

ASCS and SCS were the federal agencies that played a major role in the Tillamook project. The Tillamook ASCS Office was adequately staffed to provide administrative functions for RCWP. An item of concern by ASCS, SCS and CES was equipment. None of the three agencies had local access to computer equipment. This resulted in additional hours being spent by all agencies in the planning, implementation and administrative portions of the project.

The Tillamook County SWCD purchased an Apple II computer to be used for the project. This accelerated certain aspects of office functions for all agencies, but as time progressed, it tended to hinder the operation of various agencies. With only one computer available and different people relying on the system, it became difficult to schedule adequate time for assorted operations. This problem was resolved with the installation of computer equipment by all agencies during the past few years.

SCS was responsible for planning and implementation. The SCS field office received support from the Tillamook County SWCD which provided clerical assistance for typing water quality plans and revisions. Commuter assistance was also proved by SWCD for developing, planning and application workloads. SCS field office received strong support from the SCS area and state offices. The assistance provided has been adequate to accomplish the planning and implementation workload.

CES is responsible for the information and education program. In the beginning, CES did an excellent job of informing agricultural producers and the public about the RCWP. However, local budgetary restrictions reduced involvement once the project was well under way. Much of the CES support was shifted to the Oregon State University level. Once budgets were restored, CES has played an active role. The "Nutrient Uptake Study" that CES is conducting will be extremely useful in assisting producers improve manure utilization programs.

Environmental Protective Agency (EPA), funded 3 Tillamook County SWCD projects that supported the RCWP. These projects were:

- The 208 plan was required before an RCWP application could be submitted.

- The Site Specific Planning Project funded development of 60 RCWP water quality plans.

- The Tillamook Drainage Basin Agricultural Non-point Source Pollution Abatement Monitoring Project (205j), provided water quality monitoring funds to gather water quality data during the earlier RCWP BMP installation period.

EPA has been a strong supporter of the Tillamook Project at the national level. Their support was instrumental in obtaining additional project cost-share, technical and information and educationel funds.

In February 1990, EPA Region 10 developed a lessons learned report (19) on the Tillamook Project. The reports objectives were:

- To inventory, evaluate and document water quality lessons learned from the two RCWP Projects.

- To develop recommendations for transferring RCWP technology and lessons learned to other agricultural non-point source (NPS) in other state NPS Management Programs.

Forest Service (FS) has supported the project and worked through Oregon State Department of Forestry to assure proper forestry practices were being used in the vast forested sections of the Tillamook Bay watershed. Other federal agencies such as Economic Resource Service (ERS), and National Agricultural Statistical Service (NASS), were in attendance at SCC meetings and joined in program discussions.

FmHA made a concerted effort to provide loans to eligible dairy farmers when the assistance was needed. Thirteen loans for two million dollars have been provided to project producers, of which over $153,000 per loan were for manure facilities.

5.3 Economic Evaluation

5.3.1 Installation Costs of Each BMP and the Proportion Cost-Shared by RCWP

Total installation and cost-share figures for each BMP are shown in table 5-1 as BMP SUBTOTALS. Total installation and cost-share figures for components are also listed in this table.

- Column (1) indicates total BMP installation cost reported by participants. Figures in this column do not reflect all expense incurred by participants, because some did not report all cost associated with BMP installation.
- Column (2) lists the BMP cost-share dollars.
- Column (3) lists participants' BMP cost based on total costs reported.
- Column (4) lists the BMP cost-shared percentage.
- Column (5) lists the percentage of the total RCWP cost-shares expended.

5.3.2 Total Cost-Share Assistance Provided by RCWP and the Amount and Proportion Going to Each BMP

Total cost-share assistance provided thus far by RCWP is $3,607,342. This is listed as a total at the bottom of column (2) in table 5-1. The proportion going to each BMP is shown as BMP SUBTOTALS in column (5) of table 5-1. These figures are based on cost-share assistance provided by calendar year, ending December 31, 1990.

5.3.3 Total RCWP Project Expenditures for Technical, Financial, Education and Extension Assistance

Total RCWP Project expenditures for technical, financial, educational and extension assistance is listed in table 5-2. Data for this table accumulated as of fiscal year ending September 30, 1990. Therefore, RCWP expenditures shown in table 5-2 vary from those in table 5-1 which are calendar year expenditures.

5.3.4 Insights or Observations About the Cost-Effectiveness of Different BMPs in Reducing Pollutant Loading, and how the Overall Project Might have been Made More Cost-Effective

When the project started, contracts addressing liquid manure storage facilities included only the liquid manure storage tank as a cost-shared item. Component items were not included in the Conservation Plan of Operations (CPOs). Components required in the construction and management of a facility include: site preparation, fiber mat, rock/fill, pumps, agitators and waste transfer pipes. Failure to consider the components resulted in a wide variation of costs. Realistic average construction costs could not be established. Costs varied with tank size, accessory equipment, and time of year installed. During winter construction, rock/fill volumes and costs were higher than summer constructed facilities. Waste transfer pipe units and costs according to the distance a structure is constructed away from existing liquid manure facilities. Agitators and pump costs vary with the type or model installed.

To have realistic average cost for liquid manure storage facilities, Tillamook County ASC Committee established cost-share rates for components associated with the installation and management of the facility. This insured that producers knew what their costs and the cost-shares were prior to practice installation. This improved cost effectiveness. Cost-shares were based on local average costs that were adequate to solve the problem.

The Tillamook RCWP did not dictate the type of manure storage system. Tillamook County ASC Committee established average costs for each type of storage system. The producer was responsible for the type of system for his/her operation.

Earthen manure storage ponds were evaluated and available to participants. This practice was not popular due to the following disadvantages and/or sites restrictions:

- Many dairy operations are located in the floodplain, with poor soils are prevalent in the project area.
- Due to a 90 inch annual rainfall, large ponds would be needed to store the additional rainwater.
- Minimum evaporation
- Short construction season
- Expensive to construct. Dike material generally must come from a borrow area other than the pond site
- Generally not a socially accepted manure storage system

Although solid manure storage facilities initial costs are lower, their long term management costs are higher. Increased labor costs are associated with solid manure storage facilities. Additional bedding use such as straw or sawdust are required when managing solid manure storage facilities. This increases costs associated with solid manure handling facilities.

Roofing manure accumulation and storage areas were more cost-effective than collecting and storing excess rainfall. Tillamook County averages 90 inches of precipitation annually. Storage of polluted rainwater and applying it to pastures increases labor and equipment costs.

Tile drainage installation was evaluated. In the Tillamook Project, it costs more to provide additional manure storage than to provide adequate drainage on poorly drained pastures. Land that is adequately drained decreases storage requirements. SCS economist provided the following installation costs relationship using 1980 cost data.

A typical Tillamook County dairy has a 100 cow milking herd and 100 pastureland acres. If the land has adequate drainage, the farm would need a six months manure storage capacity. Incurred costs are as follows:

	With Drainage	Poorly Drained
Tile drainage	$40,000	-----
Dry Manure Storage	9,600	$38,400
Liquid Storage	17,150	54,850
	$66,750	$93,250

The life expectancy for each is about the same. Labor required for manure handling is about the same under either condition.

Table 5-3 lists the total costs incurred for completed systems. As of December 31, 1990, 45 producers had completed manure management system. The initial $25.81 per ton of manure handling cost is assumed to represent costs for installing the remaining animal waste systems.

Table 5-3 indicates that the average dairy that installed a complete manure management system spent $118.71 per 1,000 pound animal unit for liquid storage and $110.14 per unit for dry manure storage facilitie. Detailed analysis of the basic data that went into this table shows that on a cost per cubic foot of storage basis, there is no significant difference between systems designed solely for dry storage and systems designed solely for liquid storage. Therefore, there is no reason for the federal government to attempt to focus attention on one type of system over another. However, the costs of operating the systems are significantly different. Since farmers bear 100 percent of these costs, it is not surprising to note that they are increasingly opting for liquid storage systems because of the lower operating costs of the liquid systems and the higher bedding costs needed for the dry systems.

5.3.5 Impacts of the BMPs on Producer's Costs and Returns

Table 5-4 lists BMP implementation costs and the average annual equivalent costs of BMP's installed under the RCW Project. Considering only the costs incurred by the participants, the most meaningful data is: 1) the $107.88 per 1,000 pound animal unit implementation cost; 2) the $13.82 average annual cost per animal unit; and 3) the $1.07 average annual cost per ton of manure handled. These average annual implementation costs are equivalent to the costs of a loan amortized over the life of each BMP. They do not include the annual operation and maintenance costs of the manure management systems.

No detailed data is available regarding additional RCWP impacts on producer costs and returns. However, one study by Patchak in 1986 (20) assumed that on-farm benefits were at least equal to on-farm costs. This assumption is based on the fact that farmers voluntarily enter into the program and must therefore perceive that their on-farm benefits are at least equal to their costs. This assumption appears valid unless farmers perceived that participation in the program was necessary to prevent possible future regulation. Although this may have been a factor, it seems unlikely that it was a major factor since most farmers seem satisfied with their manure management systems installed under the valuntary RCWP.

Anecdotal information from local producers indicates the manure management systems has enabled them to manage manure properly while significantly reducing labor requirements, improving dairy health, increasing milk production, and improving manure utilization. The improved manure utilization has resulted in a notable decrease in commercial fertilizer purchases. This offers a potential for reducing nutrient loading to adjacent water courses and Tillamook Bay.

A similar situation was evaluated in southern Tillamook County (North Side Big Nestucca Watershed Project), (21) indicated that producers lose about $27 per year in nutrient values per 1,000 animal unit because of improper manure management. That $27 annual loss can be prevented through the implementation of a system whose annual on-farm cost ($13.82) is only about half as much.

A 75 percent cost-share rate was selected by the LCC to assure adequate participation. LCC believed a lower cost-share level would limit participation. A major factor for choosing the 75 percent cost-share rate was local financial institutions used the participant's RCWP contract as collateral for loans. During tight money periods, a 75 percent cost-share rate is considered necessary to assist participants obtain credit for their BMP installations costs. LCC recognized a high participation level was required if the project's water quality goals were to be achieved.

On August 23, 1983, the Internal Revenue Service (IRS), published a ruling that RCWP cost-share payments were eligible for exclusion from income tax under Public Law 96-108 and 96-5288. However, the Tillamook project was not excluded because the area exceeded the maximum acreage established for the IRS eligibility requirement.

When participants learned of IRS's decision, BMP installation slowed because participants did not want a higher tax liability. However, on October 11, 1983, IRS reversed their decision because the project area was actually within a small portion of the Tillamook Bay Watershed. After IRS's decision, BMP installation increased.

5.3.6 Offsite Benefits of RCWP

The major purpose of the Tillamook Bay Rural Clean Water Project is to improve the quality of water in Tillamook Bay thereby to reduce the potential risk of fecal coliform contamination in harvested shellfish.

An interoffice memo (Phelps to Arnold, March 1987) reports on water quality monitoring progress by the Tillamook Bay Water Quality and Annual Evaluation Committee. They noted that fecal coliform concentrations in the Bay had declined 16 to 65 percent after implementation of RCWP. However, as seen in the statistical evaluation presented in Section 8 of this report, the relationship between RCWP project activities (i.e., installation of water quality practices and systems) and fecal coliform counts was shown to be very weak though it is in the appropriate direction.

It may be that more time must elapse before the effects of those systems now in place can be observed, or that limited effects will be seen until all systems are in place.

Although no statistical relationship was observed, another measure of project success could be the extent to which changes have occurred in the number of days that shellfish harvesting has been closed on Tillamook Bay since the project was initiated. Data from the Oregon Health Department indicates the following:

Year	Number of Tillamook Bay Closures
1980	0
1981	2
1982	2
1983	1
1984	0
1985-1987	5
1988	4
1989	11
1990	4

It can be noted that there is no evidence that the number of closures have declined with implementation of the project.

The reasons cited for closure of shellfish harvesting range from sewage spills by the city to heavy rains and high water levels on the Wilson River with the majority of the instances occurring during high stages of the Wilson River.

Finally, we note that at one time, there had been a FSA Sanitary Survey of the Bay that called for the total closure of Tillamook Bay. The threat of that action was one of the major stimuli for initiating the RCWP. Without this project, Tillamook Bay would have been closed to commercial shellfish harvesting. If in fact, the project's accomplishments include assuring the continued existence of this commercial and recreation resource, then the loss which was prevented has been estimated (Patchek, 1986) at about $800,000 per year in gross commercial revenues (present value of between $4.8 million to $8.5 million in 1986 dollars) an estimated 200,000 clamming/crabbing recreational days per year (present value of between $21.7 million and $73.4 million in 1986 dollars).

Patchak's conclusions indicate that these offsite shellfishery losses prevented "...appear to be great enough to more that justify the RCWP from an economic standpoint even using conservation impact values....".

Table 5-1: RCWP Implementation Cost-Share Figures

BMP	(1) TOTAL COST	(2) COST SHARE	(3) PRODUCER COST	(4) % COST SHARED	(5) % OF C/S TOTAL
1-b PASTURE PLANTING	$820	$615	$205	75.0%	0.017%
BMP-1 SUBTOTAL	**820**	**615**	**205**	**75.0%**	**0.017%**
2-a-1(LIQ.) WASTE STORAGE STR.	1,816,038	1,223,274	592,764	67.4%	33.911%
2-a-1(DRY) WASTE STORAGE STR.	1,694,842	1,149,413	545,429	67.8%	31.863%
2-a(2-a) GUTTERING	74,765	52,847	21,918	70.7%	1.465%
2-a(2-b) ROOFING	1,327,130	914,463	412,667	68.9%	25.350%
2-a(3) BURIED MAINLINE	93,035	68,601	24,434	73.7%	1.902%
2-b EARTH STORAGE POND	65,552	40,481	25,071	61.8%	1.122%
2-d-1 CONDUIT	1,157	834	323	72.1%	0.023%
2-d-2 CURBING	42,683	30,031	12,652	70.4%	0.832%
2-e DIKE	0	0	0	0.0%	0.000%
2-f DIVERSION	29,626	14,444	14,818	49.4%	0.400%
2-g SUBSURFACE DRAIN	131,809	90,686	41,123	68.8%	2.514%
2-h SURFACE DRAIN	23,264	17,310	5,954	74.4%	0.480%
BMP-2 SUBTOTAL	**5,299,901**	**3,602,384**	**1,697,517**	**68.0%**	**99.863%**
6-a PIPELINE	428	291	137	68.0%	0.008%
6-b TROUGH OR TANK	183	137	46	74.9%	0.004%
6-c STOCK TRAILS/WALKWAYS	412	309	103	75.0%	0.009%
BMP-6 SUBTOTAL	**1,023**	**737**	**286**	**72.0%**	**0.020%**
10-b FENCING	2,911	2,183	728	75.0%	0.061%
BMP-10 SUBTOTAL	**2,911**	**2,183**	**720**	**75.0%**	**0.061%**
12-a STRUCTURE FOR WATER CONTROL	1,900	1,423	477	74.9%	0.039%
BMP-12 SUBTOTAL	**1,900**	**1,423**	**477**	**74.9%**	**0.039%**
TOTAL	**$5,306,191**	**$3,607,342**	**$1,698,849**	**68.0%**	

Table 5-2: RCWP Allocations and Expenditures

UNIT	ALLOCATION	EXPENDITURES AND COMMITMENTS	TOTAL PERCENT OF ALLOCATIONS USED
RCWP COST-SHARE FUNDS OBLIGATED	$4,540,278	$4,503,260	99%
RCWP COST-SHARE FUNDS PAID TO PRODUCERS	4,540,278	3,574,607	79%
I & E FUNDS	9,528	7,550	79%
TECHNICAL ASSISTANCE FUNDS			
SCS	690,000	523,470	76%
OTS	9,000	9,000	100%
EXTENSION	60,446	32,359	54%
SWCD	12,633	12,663	100%
SCS ANNUAL REPORT FUNDS	19,800	9,335	47%
COMPLIMENTARY COSTS	**VALUE**	**CUMULATIVE EXPENDITURE**	**PERCENT**
EST. ASCS ADMIN. COSTS	$62,786	67,545	108%
EPA (208 FUNDS DELEGATED TO TILLAMOOK SWCD FOR WATER QUALITY PLAN DEVELOPMENT	64,669	64,669	100%
205j EPA WATER PLANNING FUNDS	41,250	41,250	100%
DEQ OR OREGON STATE HEALTH DIV. GEN'L M&E AND LAB SERVICES	83,090	112,190	135%
TILLAMOOK STP LAB TESTING	9,000	5,181	58%
TILLAMOOK SWCD-WQ TESTING SUPPLIES	500	500	100%
TILLAMOOK CO. WAIVED COSTS FOR PERMITS	875	875	100%

Table 5-3: Cost-Share Figures for Dairies with Complete Manure Management Systems

BMP	(1) TOTAL COST	(2) COST SHARE	(3) DAIRY COST	(4) % COST SHARED	(5) % OF C/S TOTAL	(6) COST PER 1000# UNIT	(7) COST/TON OF MANURE
1-b PASTURE PLANT.	$ 0	$ 0	$ 0	0.0%	0.000%	0.0	0.00
2-a-1 (LIQ) STOR.STR.	1,005,480	690,119	315,361	68.6%	36.101%	118.71	9.19
2-a-1 (DRY) STOR.STR.	932,866	626,169	306,697	67.1%	32.756%	110.14	8.52
2-a(2-a) GUTTERING	35,934	25,807	10,127	71.8%	1.350%	4.24	0.33
2-a(2-b) ROOFING	744,569	499,302	245,267	67.1%	26.119%	87.91	6.80
2-a(3) MAINLINE	13,035	9,247	3,788	70.9%	0.484%	1.54	0.12
2-b EARTH POND	0	0	0	0.0%	0.000%	0.00	0.00
2-d-1 CONDUIT	0	0	0	0.0%	0.000%	0.00	0.00
2-d-2 CURBING	20,134	13,794	6,340	68.5%	0.722%	2.38	0.18
2-e DIKE	0	0	0	0.0%	0.000%	0.00	0.00
2-f DIVERSION	14,274	7,439	6,835	52.1%	0.389%	1.69	0.13
2-g SUBSUR.DRAIN	53,256	35,570	17,686	66.8%	1.861%	6.29	0.49
2-h SURFACE DRAIN	3,424	2,568	856	75.0%	0.134%	0.40	0.03
6-a PIPELINE	0	0	0	0.0%	0.000%	0.00	0.00
6-b TROUGH/TANK	0	0	0	0.0%	0.000%	0.00	0.00
6-c STOCK/TRAIL	0	0	0	0.0%	0.000%	0.00	0.00
10-b FENCING	263	197	66	74.9%	0.010%	0.03	0.00
12-a STR.WAT.CONT.	1,900	1,423	477	74.9%	0.074%	0.22	0.02
TOTALS	$2,825,135	$1,911,635	$913,500	67.7%		$333.55	$25.81

Table 5-4: Average Annual Implementation Costs for Dairies Having Complete Manure Management Systems Installed

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
	ESTIMATED	IMPLEMENTATION COSTS ($)				AVERAGE ANNUAL IMPLEMENTATION COST ($)**			
BMP	LIFE (YRS)	PROJECT	DAIRY SHARE ONLY			TOTAL	DAIRY SHARE ONLY		
		TOTAL	TOTAL	PER COW*	PER TON	PROJECT	TOTAL	PER COW*	PER TON
1-b PAST.PLANT.	8	0	0	0.00	0.00	0	0	0.00	0.00
2-a-1(LIQ)STOR.STR.	25	1,005,480	315,721	37.28	2.88	128,199	40,254	4.75	0.37
2-a-1(DRY)STOR.STR.	25	932,866	306,913	36.24	2.80	118,940	39,131	4.62	0.36
2-a(2-a) GUTTERING	10	35,934	10,133	1.20	0.09	6,360	1,793	0.21	0.02
2-a(2-b) ROOFING	25	744,569	244,963	28.92	2.24	94,933	31,233	3.69	0.29
2-a(3) MAINLINE	25	13,035	3,793	0.45	0.03	1,662	484	0.06	0.00
2-b EARTH POND	25	0	0	0.00	0.00	0	0	0.00	0.00
2-d-1 CONDUIT	25	0	0	0.00	0.00	0	0	0.00	0.00
2-d-2 CURBING	25	20,134	6,342	0.75	0.06	2,567	809	0.10	0.01
2-e DIKE	25	0	0	0.00	0.00	0	0	0.00	0.00
2-f DIVERSION	25	14,274	6,837	0.81	0.06	1,820	872	0.10	0.01
2-g SUBSUR.DRAIN	25	53,256	17,681	2.09	0.16	6,790	2,254	0.27	0.02
2-h SURFACE DRAIN	10	3,424	856	0.10	0.01	606	151	0.02	0.00
6-a PIPELINE	10	0	0	0.00	0.00	0	0	0.00	0.00
6-b TROUGH/TANK	10	0	0	0.00	0.00	0	0	0.00	0.00
6-c STOCK/TRAIL	10	0	0	0.00	0.00	0	0	0.00	0.00
10-b FENCING	10	263	66	0.01	0.00	47	12	0.00	0.00
12-a STR.WAT.CON.	10	1,900	477	0.06	0.00	336	84	0.01	0.00
TOTALS		$2,825,135	$913,783	$107.88	$8.35	$362,259	$117,078	$13.82	$1.07

**COSTS AMORTIZED OVER THE LIFE OF THE PRACTICE AT 12 PERCENT

* PER 1000 LB. COW UNIT

6.0 Monitoring Program Description

6.1 Findings and Recommendations

Findings

- Sampling frequency changed during the course of the project
- The bacteria data are highly variable and not normally distributed
- Both of the above complicate data analysis.
- The minimum parameter set for which monitoring is needed includes fecal coliform bacteria, bay salinity, river flow, and rain fall.
- Other parameters that may have value are nutrients or other chemical indicators of manure contamination.

Recommendations

- A minimum monitoring strategy should be established early in project planning and should then be adhered to throughout the project.
- Monitoring strategy should include regularly spaced sampling on a predetermined schedule, at least at a sub-set of indicator sites (i.e. monthly or even more frequent sampling).
- Methods of data analysis should be decided on early in project planning in order to ensure that data sufficient for the anticipated analysis is collected.
- Other sampling should be done in addition to, not instead of, the predetermined and scheduled sampling (e.g. intensive wet weather sampling, effectiveness monitoring, up-stream/down-stream sampling, etc., should be done only in addition to monthly monitoring)
- In order to be completely successful, the monitoring effort must receive Adequate stable funding and staffing throughout the life of the project.

6.2 General Strategy

The general purpose of the monitoring program in the Tillamook Bay project area was to gather data that would describe the condition of the bay and its tributaries with respect to water quality and affected beneficial uses. The intended uses and relevant standards are described in Oregon Administrative Rules (OAR) 340-41-202 through 340-41-215. The predominant impaired uses in the project area are shellfish growing and water contact recreation. The pollution indicator relevant to the impairment is bacteria of the coliform group associated with fecal sources. Therefore, the water quality monitoring focused largely on collection of fecal coliform bacteria samples. For shellfish growing areas the standard is a median concentration of 14 organisms per 100 milliliters (ml) of water with not more than 10 percent of samples exceeding 43 organisms per 100 ml. For all other waters within the project area the standard is 200 organisms per 100 ml, median concentration, with not more than 10 percent of samples exceeding 400 organisms per 100 ml.

Other goals of the monitoring included verification of sources of bacteria and detection of overall effects of treatment methods used for dairy waste management in the Tillamook basin. It is important to recognize that the monitoring program was not designed to determine the effectiveness of specific management practices (BMPs). The program was designed to describe ambient conditions at a number of sites. It was anticipated that changes in conditions over time could then be related to the installation of manure management systems (including multiple BMPs). It was expected that this would be particularly true on some of the smaller tributaries where similar sampling sites could be located above and below dairies that were implementing certain manure management practices over time. It was also anticipated that analysis of data collected would result in a better understanding of the dynamics of bacteria concentrations in Tillamook Bay and its major tributaries

The multiple goals of the monitoring program required that, in addition to bacteria, data for other parameters be collected as well. These included, at one or more sites, physical measurements (temperature, rainfall, river flow) and chemical measurements (salinity, dissolved oxygen, some nutrients). Multiple sampling frequencies were also required to meet the multiple goals. As a result, different sampling frequencies were employed at various times. These included routine monthly monitoring, intensive monitoring during periods of expected high runoff (storm events), and sampling up stream and down stream of particular operations.

Methods used for site selection, sample collection, sample analysis and data analysis are described in Section 6.4 below.

6.3 Climate/Meterology/Hydrology

Precipitation data was obtained from the official weather service reporting station, radio station KTIL, located near the southern tip of the bay. All sampling sites are in the lowland areas of the watershed within an eight mile radius of the radio station. Wind speed and air temperature data are also available from this site. No other precipitation data was collected.

Wilson River discharge was measured using the recording gauge operated by the U.S. Geological Survey (USGS Gauging station number 14301500). Trask River stage was observed using a staff gauge located in tidewater. Tillamook, Kilchis, and Miami River stages were measured using Oregon Water Resources Department staff gauges located just above tide water.

A dispersion study was conducted in 1980 by the Food and Drug Administration (FDA), DEQ, and Oregon State Health Division (OSHD) staff to determine the direction and speed of bacteria laden freshwater entering the upper end of the bay from the Tillamook/Trask and Wilson river discharge points. The study consisted of releasing Rhodamine B Dye in a line across the mouth of the rivers at high tide. Direction of travel, velocity, time of travel and dispersion rates were reported. Bay circulation patterns were also photographed by the Oregon National Guard. The dispersion study and photographs were used to determine overall flow patterns of freshwater entering Tillamook Bay.

6.4 Surface Water

Site Selection

The location of water quality sampling sites was oriented toward demonstration of overall, long term, trends in ambient conditions at strategic locations (e.g. oyster growing areas, main bay flow channels, major tributary water quality). Several limited duration sites were also established to provide information on the overall effects of manure management systems on specific dairy operations. This was accomplished by locating sites up stream and down stream of particular operations on minor tributaries.

There were sixteen bay sampling stations (shown in figure 6.4-1). They were located by considering the following factors:

- Historic sampling site locations.
- Potential fecal coliform source locations.
- Shellfish growing area locations.
- Accessibility of site during low tides.
- Safety in sampling during storm events.

Tributary sampling stations are shown in figure 6.4-2. These site locations were determined using the following considerations:

- Changing land use (forest/agriculture boundary).
- Up stream - down stream of specific operations.
- Major tributaries to the bay.
- Control sites (few BMPs installed up-stream).
- Accessibility of site (bridges).
- Safety in sampling during storm events.

Sample Collection

Collection of samples was done by DEQ and SCS/SWCD field personnel using approved EPA methods. Bay sampling runs were scheduled during outgoing tides. Ideally, sampling would occur at low tide when maximum bacteria concentrations would be expected (due to minimum dilution). In practice, however, much of the bay (especially the oyster beds) is not accessible at low tide. As a result, sampling only occurred when the tide was sufficiently high to allow for access to sites by boat. Bacteria samples were collected in 160 milliliter (ml) sterile glass bottles held one meter below the surface.

Tributary samples were collected at sites above the tidal reach. The larger tributaries were sampled from midstream using bridges as access points. Smaller streams were sampled from the bank. Where stream depth allowed, samples were collected from one meter below the surface. All bacteria samples (both bay and tributary samples) were placed on ice until delivered to the laboratory for analysis. Water temperature, pH and salinity were measured and recorded in the field.

Sampling Frequency

Sampling frequency varied over the ten year project period depending upon available resources and whether or not intensive monitoring protocols were in effect. Intensive, wet weather, sampling occurred during December of 1979, March and October of 1980, and March of 1985. During these surveys samples were collected every eight hours at tributary sites, and during the daylight high and low tides at bay sites. Outside of intensive monitoring periods samples were collected approximately once per calendar quarter from 1980 through September of 1986. Beginning in October of 1986 and continuing through 1990 samples were collected approximately once per month.

These differences in sampling frequencies over the life of the project complicate interpretation of the data. For the purpose of evaluating trends, all data must have been collected under similar sampling frequencies or the data must be parsed or corrected in a way that approximates a homogenous data set. For example, it would be inappropriate to use all available data to compare an annual mean from year A, that included intensive monitoring, to an annual mean from year B, that included only quarterly samples. Year A would include many more data points and would be biased toward the conditions that occurred during the intensive sampling period. The two years could be compared, however, if the data from year A were randomly parsed by quarter in order to approximate the sampling frequency that occurred in year B.

Sample Analysis Methods

Water temperature, salinity and pH were measured on site using EPA approved methods. Bacteria samples were transported, on ice, to the laboratory. After delivery they were kept refrigerated until analyzed. Maximum holding time from collection to analysis was 30 hours. For bay samples, fecal coliform (fc) bacteria were enumerated by the MPN method according to Standard Methods, 14th edition, 1975. The three tube per dilution method was used with volumes of 10, 1, and 0.1 ml of sample. This dilution scheme has become standard in the OSHD Laboratory for analysis of ambient waters by the MPN method. Fecal coliform MPN values were determined from tables in Standard Methods. All results were expressed as the number of colonies per 100 ml of sample. Bay samples were analyzed by the Oregon State Health Division Laboratory. Tributary samples were analyzed by the DEQ Laboratory using the membrane filter method using volumes of 10, 1 and 0.1 ml or 20 and 5 ml.

Data Management and Analysis

All data was entered into the EPA STORET system. Because more than one lab was involved in data analysis and staff from different agencies collected samples at different times, there was some confusion and delays in getting data entered into STORET. Some data may have been lost.

Data dumps from STORET were imported into Lotus spreadsheets for some analysis and into a DEQ statistical software package for non-parametric analysis. Data points represent discrete grab samples collected on a given day. This data was often summarized into monthly, quarterly or annual averages. Annual averages were computed using calendar years in some cases and water year (WY) in others. The water year runs from October 1 through September 30 and so includes a complete rainy season (rather than half of two separate rainy seasons in the calendar year).

Bay data were compared, over time, to the Food and Drug Administration (FDA) water quality criteria for sanitation of shellfish growing waters. The FDA recognizes three classifications of active shellfish growing areas: Restricted, Conditionally Approved, and Approved. To qualify as an approved area, the geometric mean fecal coliform concentration must be less than 14 fc/100 ml and less than ten percent of samples can exceed 49 fc/100 ml. Areas are classified as restricted when the geometric mean exceeds 88 fc/100 ml or 10 percent of values exceed 300 fc/100 ml. Areas from which data fall between the two extremes are classified as conditionally approved. Because the classifications are based on both average bacteria concentration and number of exceedances of a set concentration, any change in classification would provide a convenient indicator of a change in water quality that affects a specific use, i.e. shellfish harvesting.

The comparison to FDA criteria was intended to give an indication of how various sites related to the "restricted", "conditionally approved", and "approved" FDA classifications and how those relationships changed over the course of the project. It is understood that the FDA criteria were developed to classify entire growing areas; not individual sampling sites. However, comparison to the criteria provide convenient reference points to determine changes in water quality. If, for example, a site that has met the "approved" criteria falls over time to the "conditionally approved" category then there has been an important decrease in water quality that affects an identified use.

A number of difficulties were encountered when attempting to analyze the data for statistically significant trends. For the purpose of this report, statistically significant means 90 percent confidence. Difficulties encountered include:

- The data sets are not homogeneous in terms of sampling frequency.
- The data are not normally distributed. In fact the data set is very highly skewed and even when log-transformed it does not approximate a normal distribu tion.
- Because it is a biological parameter (rather than chemical) the fecal coliform sampling and analysis methods are inherently highly variable. Large numbers of samples are needed to trend highly variable parameters.
- Ambient bacteria concentrations are influenced by a number of complicating factors which can be hard to correct. These include stream flow, tidal fluctuation, salinity, meteorological conditions, and human activities (e.g., appli cation of BMPs). So even if a significant change is observed it is difficult to assign cause and effect.

For evaluating trends, data were parsed to monthly or quarterly values. In some cases data from multiple sites were pooled. Frequency histograms were developed. Trends were estimated using the Seasonal Kendall Test (a non-parametric trend indicator) and, in some cases, ordinary least squares regression (a parametric technique). The ordinary least squares regression was used for comparison because it is a well known test. It is not an optimal test for the data set, however, because it assumes a normal distribution of optional data.

Differences between the mean fecal coliform concentration of samples collected during different storm events (intensive monitoring) were compared using the Wilcoxon-Mann-Whitney test (a non-parametric technique).

6.5 Ground Water

No ground water monitoring was conducted in conjunction with this study.

Figure 6 . 4 - 1

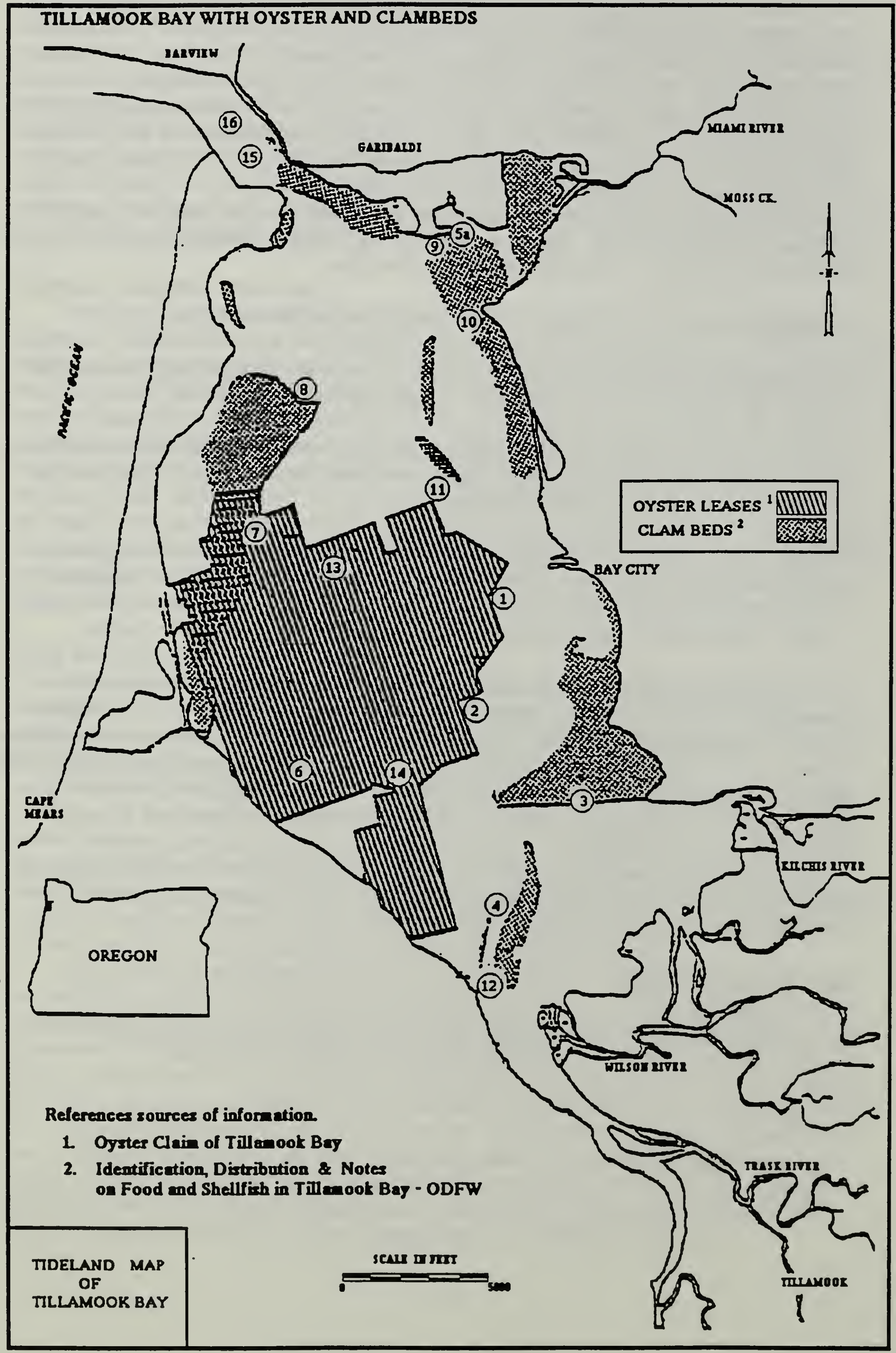
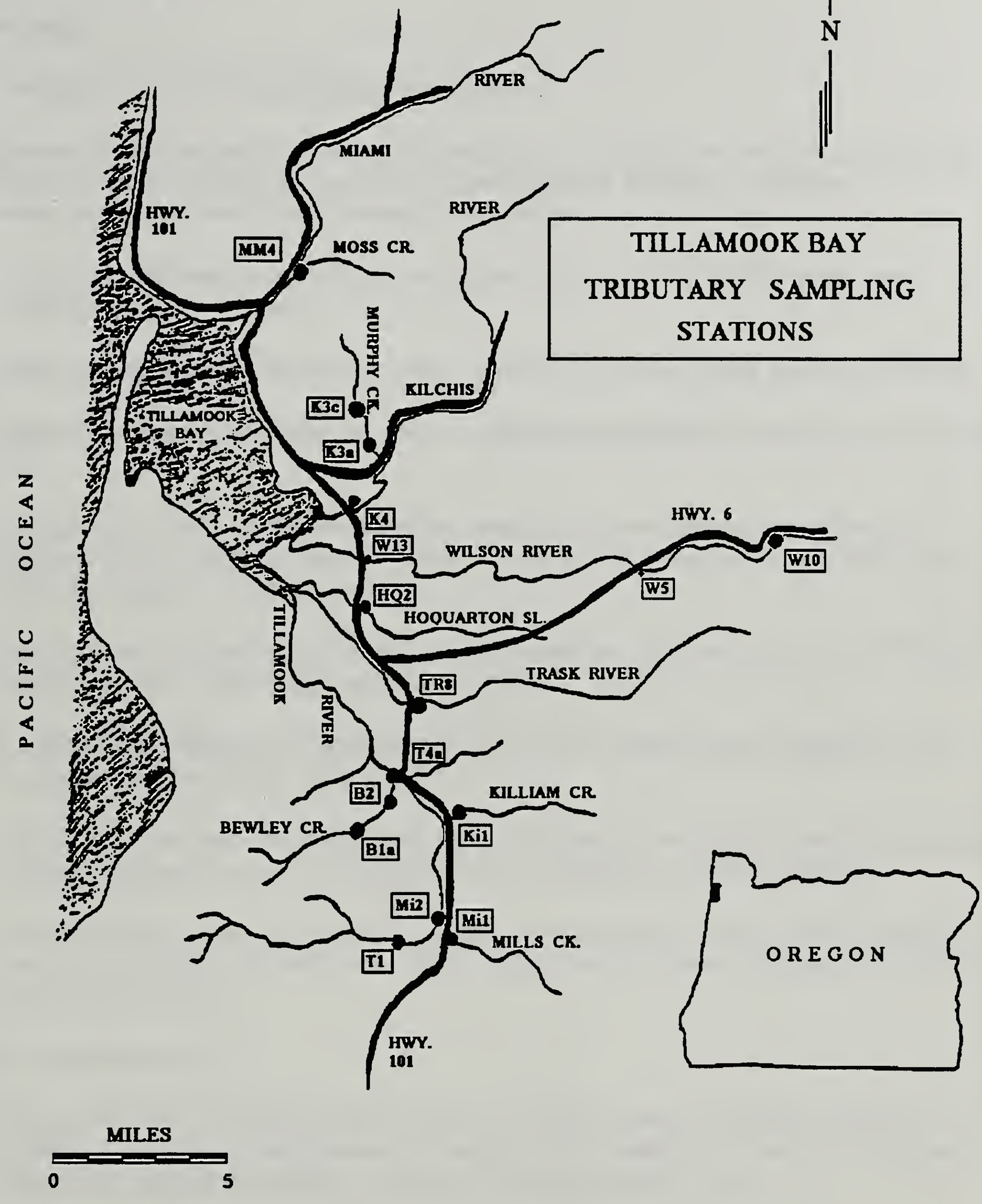

TILLAMOOK BAY WITH OYSTER AND CLAMBEDS
BARVIEW
GARIBALDI
MIAMI RIVER
MOSS CK.
N
PACIFIC OCEAN
BAY CITY
OYSTER LEASES [1]
CLAM BEDS [2]
CAPE MEARS
KILCHIS RIVER
OREGON
WILSON RIVER
TRASK RIVER
TILLAMOOK
1
2
3
4
5a
6
7
8
9
10
11
12
13
14
15
16
References sources of information.
1. Oyster Claim of Tillamook Bay
2. Identification, Distribution & Notes on Food and Shellfish in Tillamook Bay - ODFW
TIDELAND MAP OF TILLAMOOK BAY
SCALE IN FEET
0
5000

FIGURE 6.4 - 2


TILLAMOOK BAY
TRIBUTARY SAMPLING
STATIONS
N
MIAMI
RIVER
RIVER
HWY.
101
MM4
MOSS CR.
MURPHY CK.
KILCHIS
K3c
K3a
TILLAMOOK
BAY
PACIFIC OCEAN
K4
W13
WILSON RIVER
HWY. 6
W10
W5
HQ2
HOQUARTON SL.
TILLAMOOK
RIVER
TR8
TRASK RIVER
T4a
KILLIAM CR.
B2
BEWLEY CR.
B1a
Ki1
Mi2
Mi1
MILLS CK.
T1
HWY.
101
OREGON
MILES
0
5

7.0 Monitoring Results

7.1 Findings and Recommendations

Findings

- Precipitation during the study period was normal.
- Bacteria laden freshwater entering the south end of the bay can, and does, influence bacteria concentrations at the shellfish growing areas, however, most fresh water probably travels down the east side channel.
- In general, bacteria concentrations are higher in the east bay channel than over the shellfish growing areas.
- Water quality improvements have likely occurred in Tillamook Bay and its tributaries.
- Statistically valid trends have not been successfully established using the current data set.
- Comparison of worst case (wet weather) events indicates that maximum bacteria concentrations may have been reduced. However, this observation is limited by the ability to compare only two events.
- Exceedances of standards for bacteria concentrations occurred prior to the RCWP and continue to occur at both bay and tributary sites.
- Bacteria concentrations are significantly higher down stream of farm operations (as compared to immediately up stream).
- Wilson River bacteria concentrations did not increase even though river flow decreased during the project period. This may indicate a decrease in bacteria loading.
- Because water quality improvements would be expected to occur for some period of time after all RCWP contracts are fulfilled, it is too early to make final assessments of the results of the RCWP.

Recommendations

- Regular monthly sampling should continue to allow for more complete evaluation of the RCWP at a later date (improvements resulting from installation of manure management practices would be expected to continue for some period of time).
- Additional intensive monitoring studies, particularly during summer/fall runoff episodes, would be useful both for evaluating installed practices and for identifying “hot spots” that need further work.
- Funding should be secured to perform additional data analysis (both of existing data and future data) after 3-5 more years of data are collected.

7.2 Climate/Meterologic/Hydrologic

Precipitation during the 12 year study period (1979-1990) was normal. Annual average precipitation during this study was 84 inches. Annual rainfall ranged from a maximum of 105 inches in 1988 to a minimum of 61 inches in 1989 (30 year average for 1940-70 = 94 inches). The wettest month on average was November (12.55 inches) while the driest was August (1.05 inches). Seventy-five percent of precipitation occurred during the months of October through March. Figure 7.2-1 displays monthly rainfall data. Daily precipitation data is available.

Average monthly flow at the USGS recording gauge on the Wilson River ranged from a maximum 3790 cfs in January of 1990 to a minimum of 43 cfs in October of 1987. On average, the highest flows occurred in December and February while the lowest occurred in August. The maximum annual volume of 946,868 acre-feet occurred in 1982. The minimum annual volume of 495,763 acre-feet occurred in 1985. Eighty percent of Wilson River discharge occurred during the months of October through March. Figure 7.2-2 displays the mean daily flow (monthly average). Not surprisingly, the river flow data displays a pattern very similar to the rainfall data. Trend analysis indicates a slight downward trend in Wilson River flow over the course of the study.

Tillamook Bay dispersion studies were conducted in 1980. The studies were intended to determine the proportion of freshwater flow entering the head of the bay that traveled east into the Bay City Channel and what proportion traveled into South Channel to the west (where the majority of the oyster beds are located). Two dye tracing studies were carried out; one on the Tillamook River and one on the Wilson River. Dye was released at high tide so that dispersion could be traced on the ebb tide. The studies indicated under the conditions present on the sampling days (September 3 and 4, 1980) about 36 percent of Tillamook River water traveled east of Dick Point to the Bay City Channel. The remaining 64 percent traveled west to South Channel (See Figure 7.2-3 for channel locations). About 58 percent of Wilson River flow traveled east of Dick Point and 42 percent traveled west into South Channel.

7.3 Surface Water

Tillamook Bay FDA Classifications

By applying the FDA classification criteria (refer to section 6.4, Data Management and Analysis) to three year blocks of data from individual sampling sites (rather than entire growing areas) changes in the bay's ability to support shellfish harvesting are revealed. The results of this process are summarized below and in Figure 7.3-1. Site specific data are contained in Table 7.3-1.

Year	No. Sites Restricted	No. Sites Cond. Approved	No. sites Approved
WY80-82	12	2	0
WY81-83	5	8	1
WY82-84	11	2	1
WY83-85	7	6	1
WY84-86	3	8	3
WY85-87	1	8	5
WY86-88	4	8	2
WY87-89	5	7	2
WY88-90	6	8	0

It can be seen from the summary that when the FDA criteria are applied to 14 bay sampling sites, 12 sites would have been classified as restricted at the beginning of the Tillamook Bay RCWP. Two sites would have been classed as conditionally approved and no sites would have been fully approved. Gains were made through the mid-1980's so that for the three year period included in WY85-87 only one site would have been restricted, eight sites would have been conditionally approved, and 5 sites met the requirements for fully approved. There appears to have been some back-sliding since that time so that at the end of WY90 there were six sites that fit the criteria for restricted, eight conditionally approved, and no sites met the criteria for fully approved. Comparing the ending classifications to the beginning classifications still appears to support the conclusion that the bay's water quality, as it relates to shellfish harvesting, was improved after implementation of the RCWP. However, it must be recognized that the data prior to 1985 includes intensive wet weather sampling while the data after 1985 does not. This difference in sampling could be responsible for at least some of the apparent improvement. The fact that no sites met the FDA requirements for an approved shellfish harvesting area for the three year period of WY88-90 demonstrates that, while some improvement in water quality may have occurred, exceedances of standards for shellfish harvesting still occur in Tillamook Bay.

Spatial Differences

The circulation of water within the bay is influenced by tides, wind, channel size, stream gradient, fresh water runoff intensity and many other factors. The balance between these factors, along with the bacteria load in the waters entering the bay, determines the fecal coliform concentration experienced at the shellfish growing areas. These same factors influence the length of time that bacteria concentrations, once elevated, will remain high before being flushed away, dying off, or becoming diluted.

Table 7.3-2 summarizes fecal coliform data from the bay sampling stations. The site that tends to have the highest bacteria concentration is station 12. This site is located at the extreme south end of the bay near the south end of the Dick Point Dike. This is not far from where the discharges of the Wilson, Trask, and Tillamook Rivers enter the bay. The 1980 dispersion study (discussed in Section 7.2, above) indicated that a portion of the water reaching this point will enter South Channel were it could potentially carry bacteria over the oyster beds. The remainder of the water would flow along the dike to the northeast and into the Bay City Channel. The next two highest sites on average are stations 3 and 4. Station 4 is located near the north end of the Dick Point Dike and station 3 is located even farther to the northeast. The relatively high bacteria concentrations at these sites may indicate that most of the bacteria laden fresh water is moving into the main east side channel that carries water from the head of the bay to the ocean.

Stations 6, 14, 2, and 3 roughly form a west to east traverse across the bay (station 2 is some what north of the others). It can be seen from Table 7.3-2 that the average geometric mean bacteria concentration gets progressively higher as you move from station 6 across the bay to station 3. This further supports the theory that most of the bacteria are either entering or being carried to the east side of the bay.

Stations 8, 7, 13, 11, 1, 2, 14, and 6 roughly outline the commercial shellfish growing area. These sites are generally lower in bacteria concentration than the sites to the south (stations 3, 4, and 12). This makes sense because they are farther from the rivers that enter the south end of the bay. Again, the sites on the east side of the growing area (stations 11, 1, and 2) tend to have higher bacteria concentrations than the other growing area sites.

Station 5a is another relatively high site. This is somewhat surprising because it is a north bay site. Another nearby site (station 9), and two other north bay sites (15 and 16) display much lower bacteria concentrations. Station 5a is located in the northeast part of the bay near a marina close to the mouth of the Miami River. The site may be influenced by a local source in the marina or by the Miami River. The Garibaldi sewage treatment plant outfall is near the site. However, samples of the treatment plant effluent are generally much lower in bacteria concentration than the concentrations observed at the site. It is also important to note that at the marina site the pre-WY80-82 data are much higher than the post-WY80-82 data. This may be an artifact of the 1979/80 wet weather sampling previously mentioned but the difference in concentrations appears to be greater at this site than at other sites.

Trends

In an attempt to determine if there were any demonstrable trends in thebacteria concentrations at the oyster growing areas, data from stations 7, 8 and 11 were pooled. As described in Section 6.4, a number of difficulties were encountered when attempting to demonstrate statistical trends. The data were first log transformed, then a frequency histogram of the data (parsed to monthly values) was developed. Figure 7.3-2 clearly shows that the log transformed data does not approach a normal distribution. For that reason, non-parametric methods were used. Because sampling frequency varied drastically over the course of the study it was necessary to parse the data randomly into four quarters per year (this was the only sampling frequency for which data were available for the entire study period). The data set was then tested for trends and statistical significance using the Seasonal Kendall Test. Figure 7.3-3 illustrates that no trend was demonstrated.

Because it was possible that a trend did exist, but was being masked by the effect of salinity (or river flow), the relationship between fecal coliform bacteria and salinity in Tillamook Bay was determined (Figure 7.3-4). The data was then corrected for salinity and the Seasonal Kendall Test was re-run. It can be seen from Figure 7.3-5 that, again, no significant trend was identified. The test was also run on data from the individual (not pooled) stations with similar results.

The shellfish growing area on the west side of the bay generally has lower bacteria concentrations than the east side stations. It was also suspected that the flow from the Tillamook, Trask, Wilson, and Kilchis Rivers has more influence on the deep east bay channel than on the shallow west side growing area. It was therefore hypothetically possible that a trend could be demonstrated in the east bay even if no trend could be demonstrated in the growing area. To test this hypothesis data from stations 2, 3, 4, and 10 were pooled, parsed by quarter, and salinity adjusted. Again, the Seasonal Kendall Test could detect no significant trend (Figure 7.3-6).

It is important to recognize that the inability to demonstrate a trend in the fecal coliform bacteria data in Tillamook Bay does not necessarily mean that there was no change in water quality. Fecal coliform bacteria is a highly variable parameter. Highly variable parameters require very large data sets in order to reliably demonstrate trends. Because quarterly sampling was the frequency available for the entire study period, the Tillamook data set is quite limited (for evaluating trends). Data continues to be collected and regular monthly sampling has occurred since 1986. As the data set grows, trends may become apparent. Because of the variability, however, monthly sampling may still not be adequate to demonstrate significant trends unless changes in bacteria concentration over time are large.

Storm Comparisons

It is the high bacteria concentrations that are of most concern and that the RCWP was intended to reduce. Because those high values tend to be associated with periods of high runoff (rain storms) a comparison of similar storm events from before and after RCWP implementation could show changes in the magnitude of high bacteria concentrations. Ideally, one would compare the first storms of the fall (following the dry season) since this would be when the maximum manure runoff would be expected. The data set available, however, was from spring storm events.

Intensive wet weather sampling occurred in March of 1980 and again in March of 1985 (after implementation of the RCWP was well under way). Fecal coliform data were gathered, log transformed, and pooled from sites 7, 8, and 11. The mean of the samples from each year was then compared using the non-parametric Wilcoxon-Mann-Whitney test. Figure 7.3-7 demonstrates that the 1985 storm had significantly lower bacteria concentrations; about 50 percent lower. This is only a comparison of two storms, but the difference between the mean bacteria concentration is highly significant (95 percent confidence). Of course many factors other than the RCWP could be responsible for this difference. The most important of the "other factors" is the intensity of rain fall and amount of runoff that occurred. To get at the possible influence of runoff the Wilson River flow and bay salinity for the same time periods was compared. Figures 7.3-8 and 7.3-9 show that the river flow was significantly less and the bay salinity was significantly higher during the 1985 storm as compared to the 1980 storm. Both of these facts indicate that the 1980 storm was of greater intensity and so there was probably more runoff occurring in 1980 as compared to 1985. This difference in runoff volume is undoubtedly responsible for at least part of the difference between the bacteria concentrations.

Tributaries Trends

Data from tributaries were subject to the same problems with homogeneity, distribution, and variability discussed previously. The tributary data were parsed and analyzed for trends using the Season Kendall Test as described for the bay sites. Statistically valid trends were not apparent. The situation is illustrated with data from the Wilson River in figure 7.3-10. The Seasonal Sen Slope is slightly negative. A negative slope would indicate a decreasing trend in bacteria concentration (increasing water quality). However, the trend is not significant at the 80 percent confidence level. Figure 7.3-11 displays data from the Tillamook River. Both the ordinary least squares (OLS) regression line and the season sen slope are displayed. This figure is included here to illustrate the danger in applying the OLS regression to a parameter that is not normally distributed. The OLS slope indicates a trend toward increasing bacteria concentrations (decreasing water quality). The non-parametric Seasonal Kendall Test (which is more appropriate to the data) indicates that there is no significant trend, up or down, in the Tillamook River data.

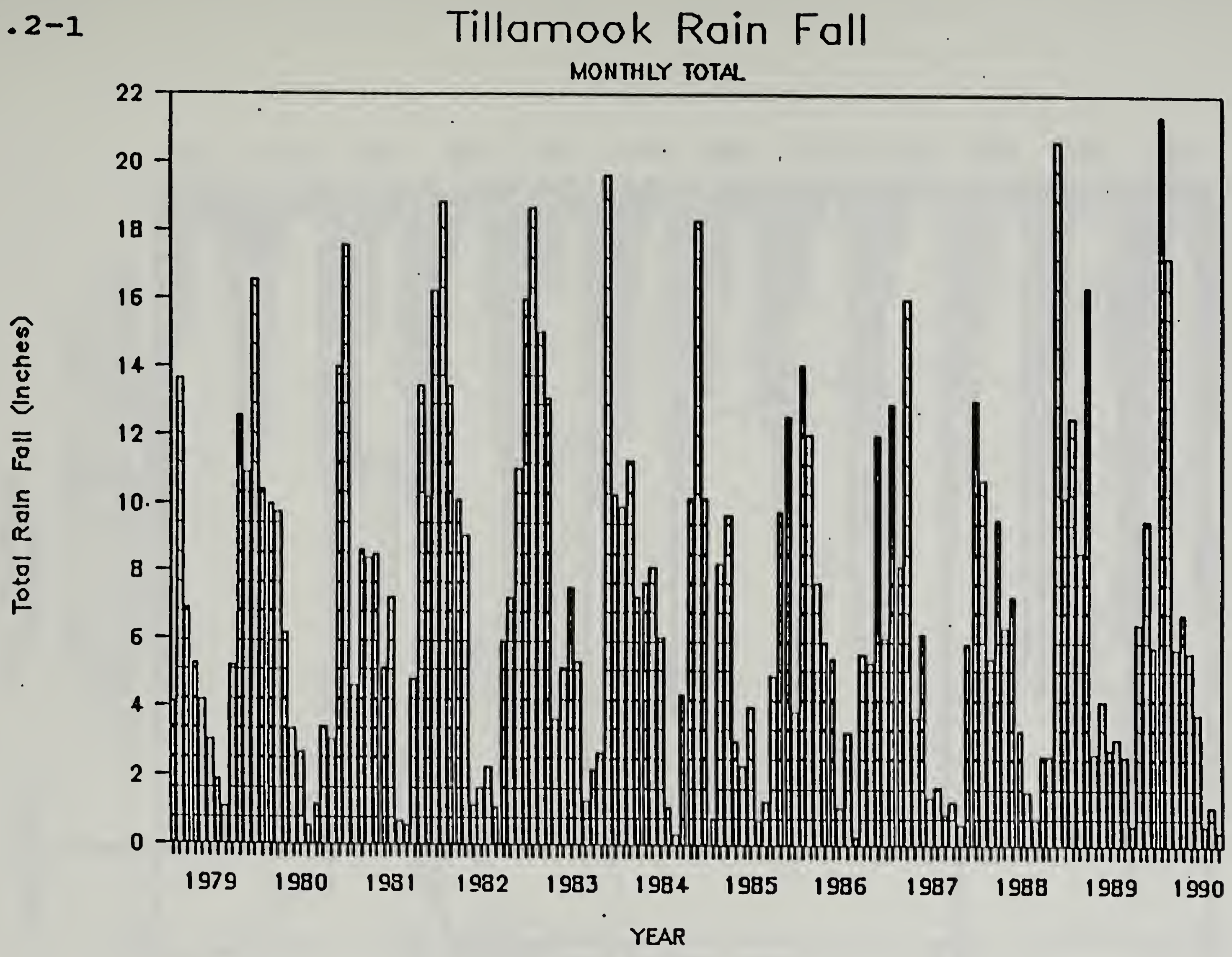
As with the bay data, it is important to recognize that the statistical analysis shows only that a trend could not be demonstrated. If the results had been significant (at the 90 percent confidence level) then we could be confident that a trend exists. However, the converse is not true. The lack of significance does not mean that a trend does not exist. The inability to demonstrate a trend may well be due to the limitations of the data set. The RCWP project period is only now drawing to a close. After installation of all practices is complete it would be expected that water quality improvements, if they are occurring, would continue to improve for some period of time (assuming that installed manure management systems are properly maintained). It is too early to make final conclusions about the effects of the RCWP using only data through 1990. Data continues to be collected and should be reevaluated in the future.

It would be expected that any change in bacteria concentrations during the RCWP would be a function of both river flow and changes in bacteria loading. Figure 7.3-12 shows the trend in river flow for the Wilson River over the course of the RCWP. The figure demonstrates a significant trend toward decreasing river flow. If the bacteria loading remained constant during the past ten years but the flow decreased then it would be expected that the bacteria concentrations would increase. The fact that the river flow decreased while no increase in bacteria concentration was demonstrated, may be indirect evidence that the bacteria loading was reduced during the RCWP.

Up-Stream/Down Stream /Sampling

As previously described, bacteria sampling was conducted up-stream and down-stream of a number of dairy operations in the Tillamook Bay project area. This sampling clearly established that bacteria concentrations increase dramatically as one moves from up-stream of a dairy to a down stream location. Presumably this is a result of bacteria entering the stream between the two points. The phenomenon is illustrated with data from Murphy Creek in figure 7.3-13. The mean of all available data points up-stream is compared to the down-stream mean using the Wilcoxon-Mann-Whitney test. The result is a highly significant difference between the two means with the up-stream concentrations an order of magnitude lower than down-stream. If practices installed as a result of the RCWP are reducing the amount of bacteria in the run off from the farms, then one would expect the two means to approach each other over time. Unfortunately there was not enough data at this site to determine if the means are getting closer together. Additional sampling and data analysis at this and other sites would be very useful.

Figure 7.2-1



Tillamook Rain Fall
MONTHLY TOTAL
Total Rain Fall (Inches)
0
2
4
6
8
10
12
14
16
18
20
22
1979
1980
1981
1982
1983
1984
1985
1986
1987
1988
1989
1990
YEAR

Figure 7.2-2

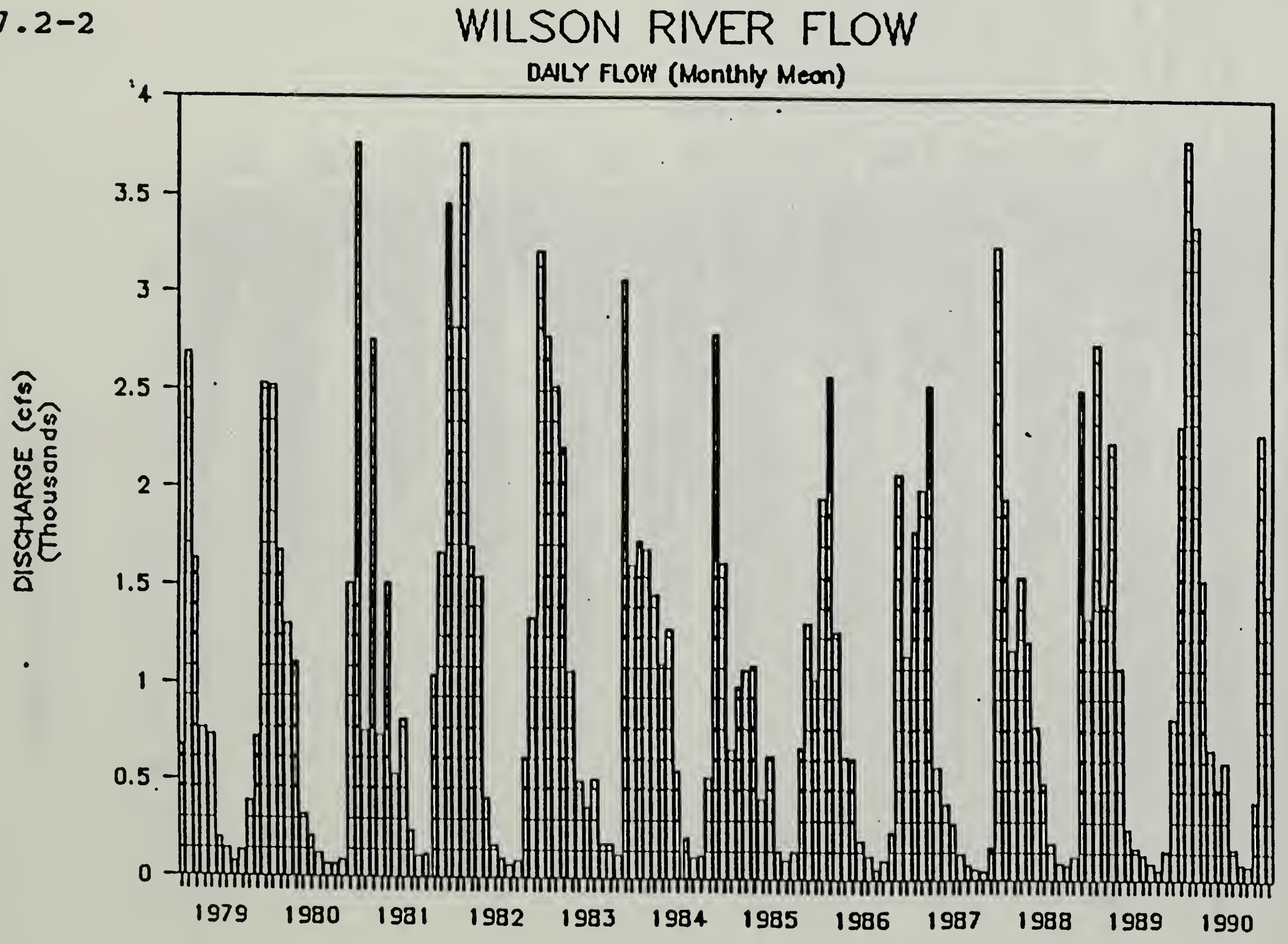
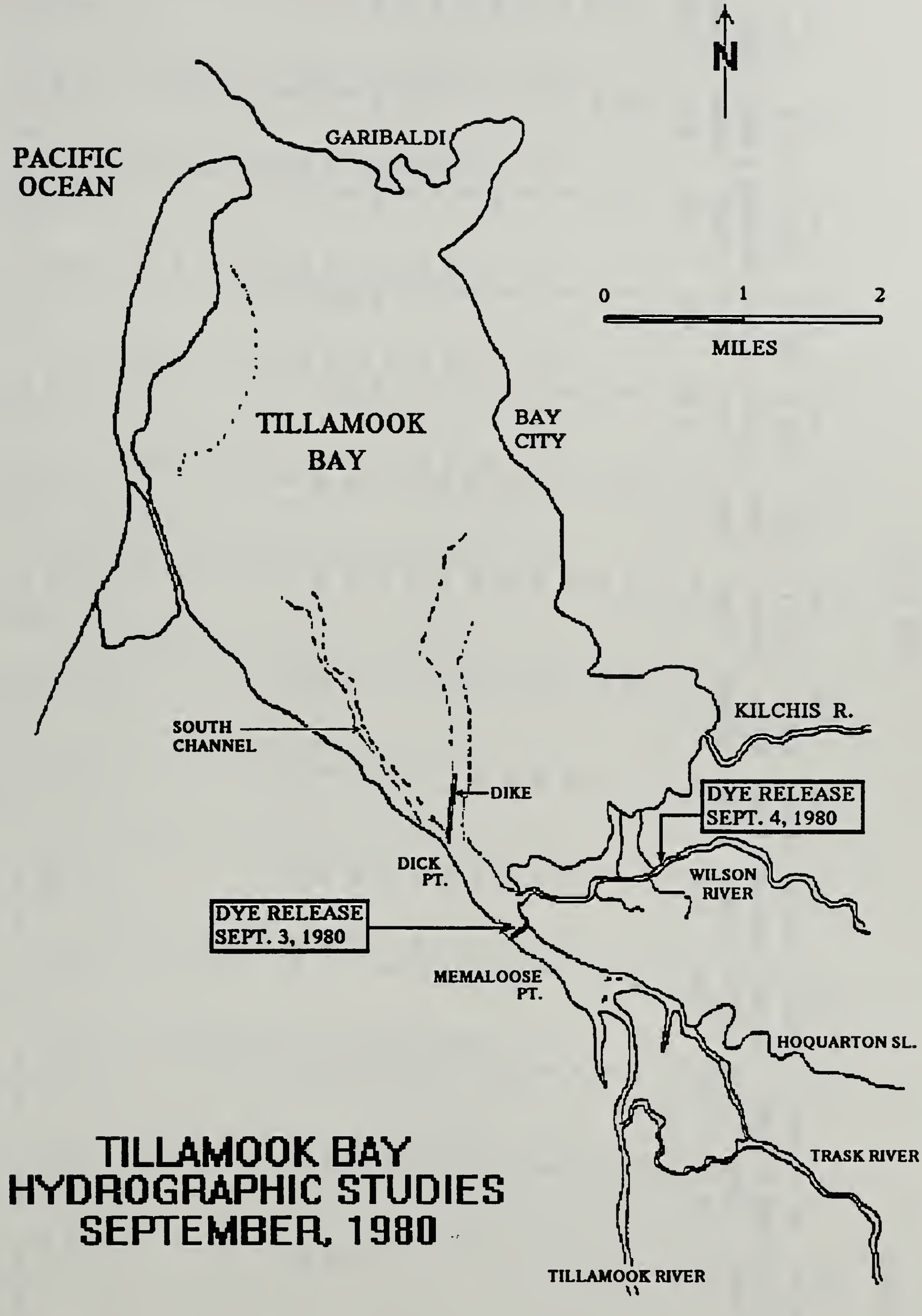

WILSON RIVER FLOW
DAILY FLOW (Monthly Mean)
DISCHARGE (cfs)
(Thousands)
4
3.5
3
2.5
2
1.5
1
0.5
0
1979
1980
1981
1982
1983
1984
1985
1986
1987
1988
1989
1990

FIGURE 7.2 - 3


N
0
1
2
MILES
PACIFIC OCEAN
GARIBALDI
TILLAMOOK BAY
BAY CITY
KILCHIS R.
SOUTH CHANNEL
DIKE
DYE RELEASE SEPT. 4, 1980
DICK PT.
WILSON RIVER
DYE RELEASE SEPT. 3, 1980
MEMALOOSE PT.
HOQUARTON SL.
TRASK RIVER
TILLAMOOK RIVER
TILLAMOOK BAY
HYDROGRAPHIC STUDIES
SEPTEMBER, 1980

FDA CLASSIFICATION

TADLE 7.3-1

	TILL STA 16 BAR-WEST 412521 1.30	TILL STA 15 BAR-EAST 412520 1.60	TILL STA 9 MARK 19 412014 2.20	TILL STA 5a MARINA 412178 ·2.50	TILL STA 8 .NW BAY 412013 2.50	TILL STA 10 HOBSON PT 412015 2.50	TILL STA 13 N BAY 412234 3.10	TILL STA 11 NE BAY 412016 3.30	TILL STA 7 SW BAY 412012 3.70	TILL STA 1 N DOLPH 412006 4.00	TILL STA 6 S BAY 412011 4.30	TILL STA 14 SE BAY 412176 4.50	TILL STA 2 MID DOLPH 412007 4.60	TILL STA 3 S DOLPH 412008 5.20	TILL STA 4 N DIKE 412009 5.50	TILL STA 12 S DIKE 412153 6.30
WY77-WY79	..	..	R	..	CA	A	..	CA	CA	CA	R	R	R	CA	R	R
WY78-WY80	..	..	R	R	R	R	CA	CA	R	R	R	R	R	R	R	R
WY79-WY81	..	..	R	R	R	R	CA	..	R	R	R	R	R	R	R	R
WY80-WY82	..	..	R	R	R	R	CA	CA	R	R	R	R	R	R	R	R
WY81-WY83	..	..	CA	CA	CA	A	CA	R	CA	CA	R	R	CA	R	CA	R
WY82-WY84	..	..	A	R	R	CA	R	R	R	CA	R	R	R	R	R	R
WY83-WY85	..	..	A	CA	CA	CA	CA	R	CA	CA	R	R	R	R	R	R
WY84-WY86	..	..	A	CA	CA	CA	A	A	CA	CA	R	CA	R	CA	CA	R
WY85-WY87	A	A	A	CA	A	CA	A	A	A	CA	CA	CA	CA	CA	CA	R
WY86-WY88	A	CA	CA	CA	A	CA	A	CA	CA	CA	CA	CA	R	R	R	R
WY87-WY89	A	CA	CA	CA	A	CA	A	CA	CA	CA	R	CA	R	R	R	R
WY88-WY90	A	CA	CA	CA	CA	CA	CA	CA	CA	R	R	CA	R	R	R	R

GEOMETRIC MEANS

TABLE 7.3-2

	TILL STA 16 BAR-WEST 412521 1.30	TILL STA 15 BAR-EAST 412520 1.60	TILL STA 9 MARK 19 412014 2.20	TILL STA 5a MARINA 412178 2.50	TILL STA 8 NW BAY 412013 2.50	TILL STA 10 HOBSON PT 412015 2.50	TILL STA 13 N BAY 412234 3.10	TILL STA 11 NE BAY 412016 3.30	TILL STA 7 SW BAY 412012 3.70	TILL STA 1 N DOLPH 412006 4.00	TILL STA 6 S BAY 412011 4.30	TILL STA 14 SE BAY 412176 4.50	TILL STA 2 MID DOLPH 412007 4.60	TILL STA 3 S DOLPH 412008 5.20	TILL STA 4 N DIKE 412009 5.50	TILL STA 12 S DIKE 412153 6.30
WY77-WY79			13		8	10		10	10	52	23	20	71	73	156	103
WY78-WY80			38	183	27	26	26	10	39	62	54	60	75	124	164	205
WY79-WY81			32	123	19	17	19		29	42	33	47	51	79	94	142
WY80-WY82			30	117	19	19	20	17	30	43	34	48	52	85	95	149
WY81-WY83			11	39	8	5	0	9	12	16	12	33	23	44	34	58
WY82-WY84			9	26	16	12	16	11	15	16	24	40	64	109	53	109
WY83-WY85			8	22	8	12	7	10	11	15	18	14	37	32	43	95
WY84-WY86			8	21	6	10	5	9	11	13	16	9	27	21	32	84
WY85-WY87	5	6	8	18	6	14	5	9	10	18	14	11	30	31	43	89
WY86-WY88	5	7	13	22	8	13	4	10	17	25	21	20	37	52	45	61
WY87-WY89	5	7	16	35	10	13	6	13	17	36	25	30	49	58	50	68
WY88-WY90	5	8	15	23	11	13	9	15	14	62	23	41	67	74	65	82
Average	5	7	17	57	12	14	11	11	18	33	25	31	49	65	73	104

Figure 7.3-1

FDA Classification

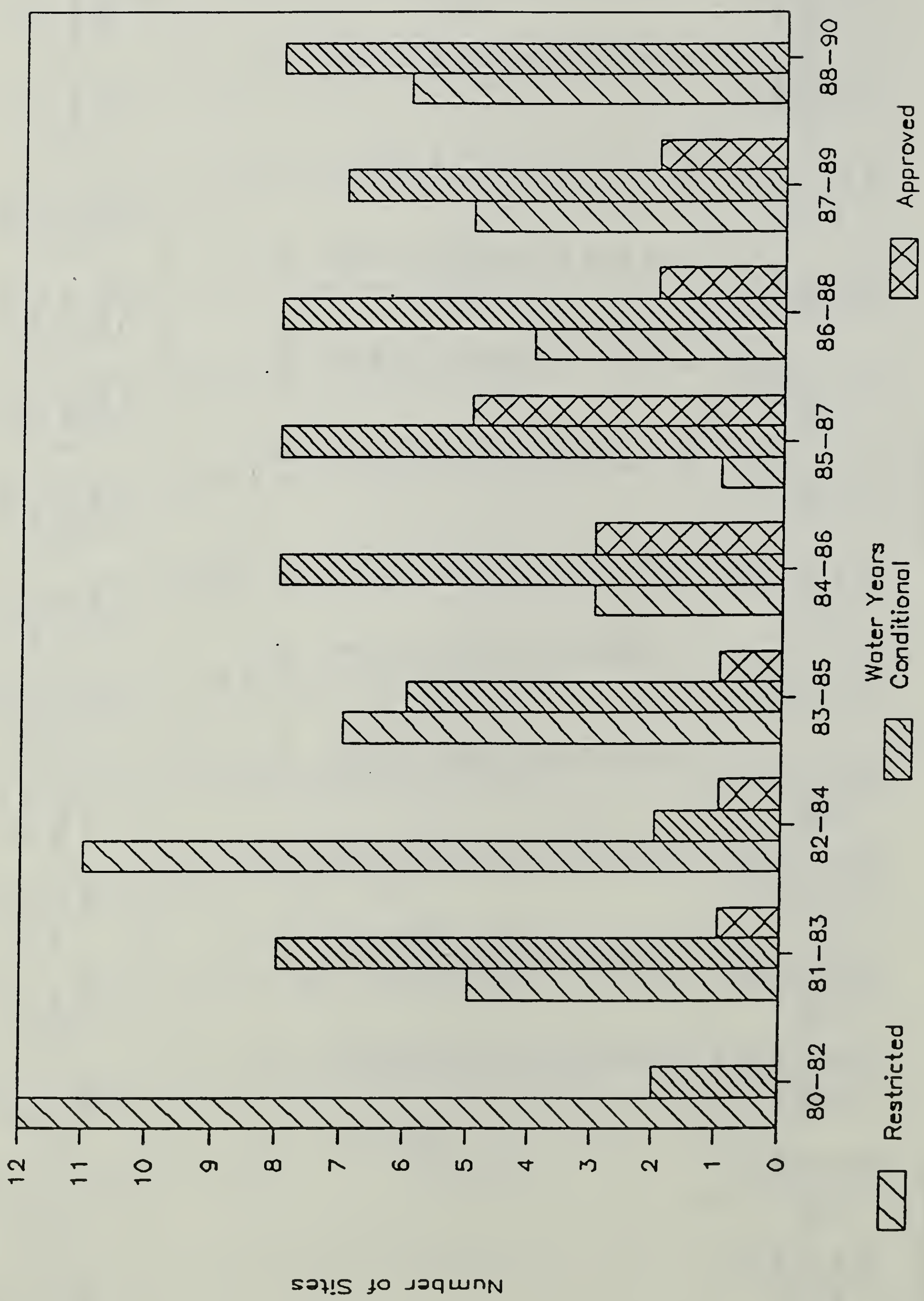


Figure 7.3-2

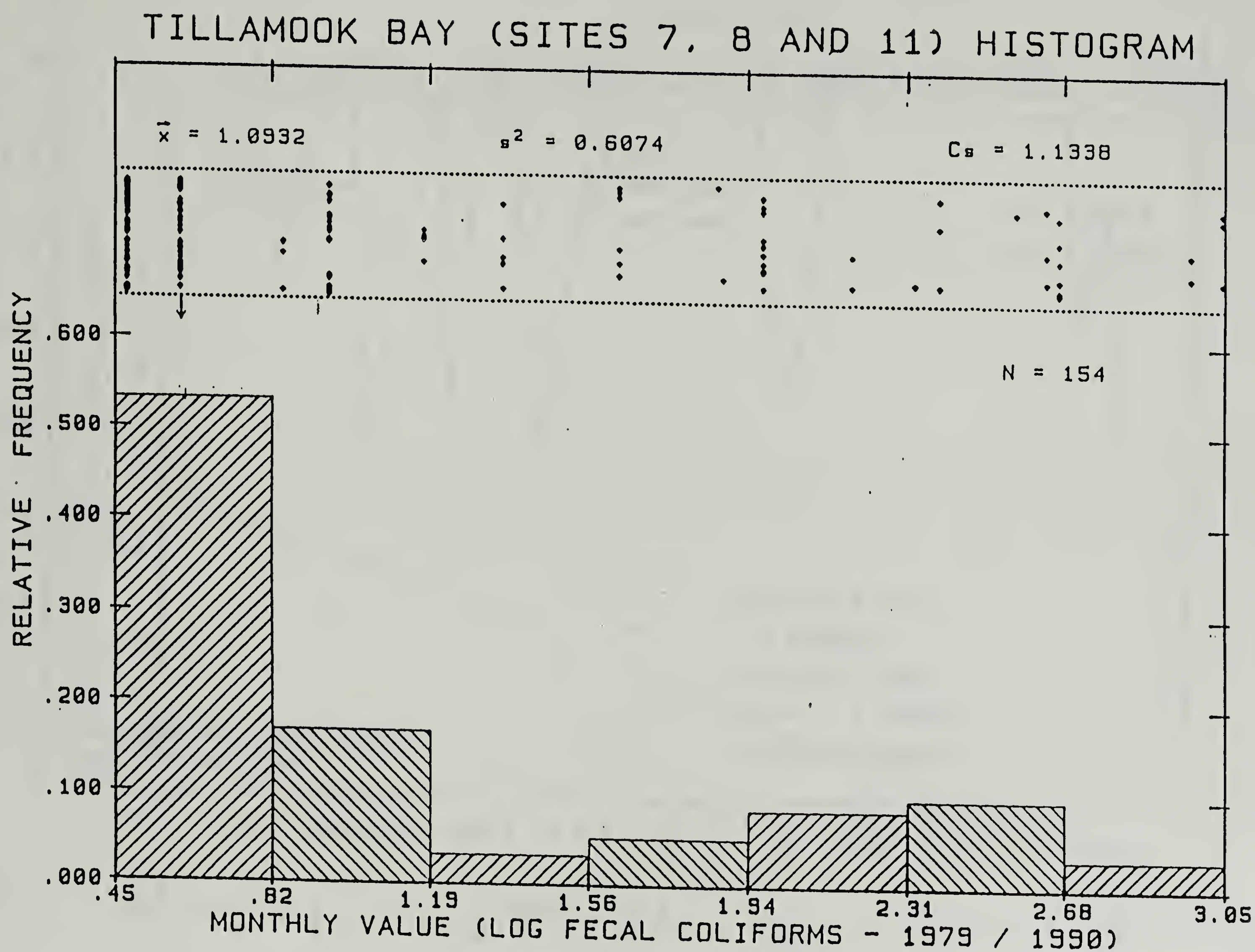

TILLAMOOK BAY (SITES 7, 8 AND 11) HISTOGRAM
$\bar{x}$ = 1.0932
s^2 = 0.6074
Cs = 1.1338
N = 154
RELATIVE FREQUENCY
.600
.500
.400
.300
.200
.100
.000
.45
.82
1.19
1.56
1.94
2.31
2.68
3.05
MONTHLY VALUE (LOG FECAL COLIFORMS - 1979 / 1990)

Figure 7.3-3

TILLAMOOK BAY (SITES 7, 8 AND 11)

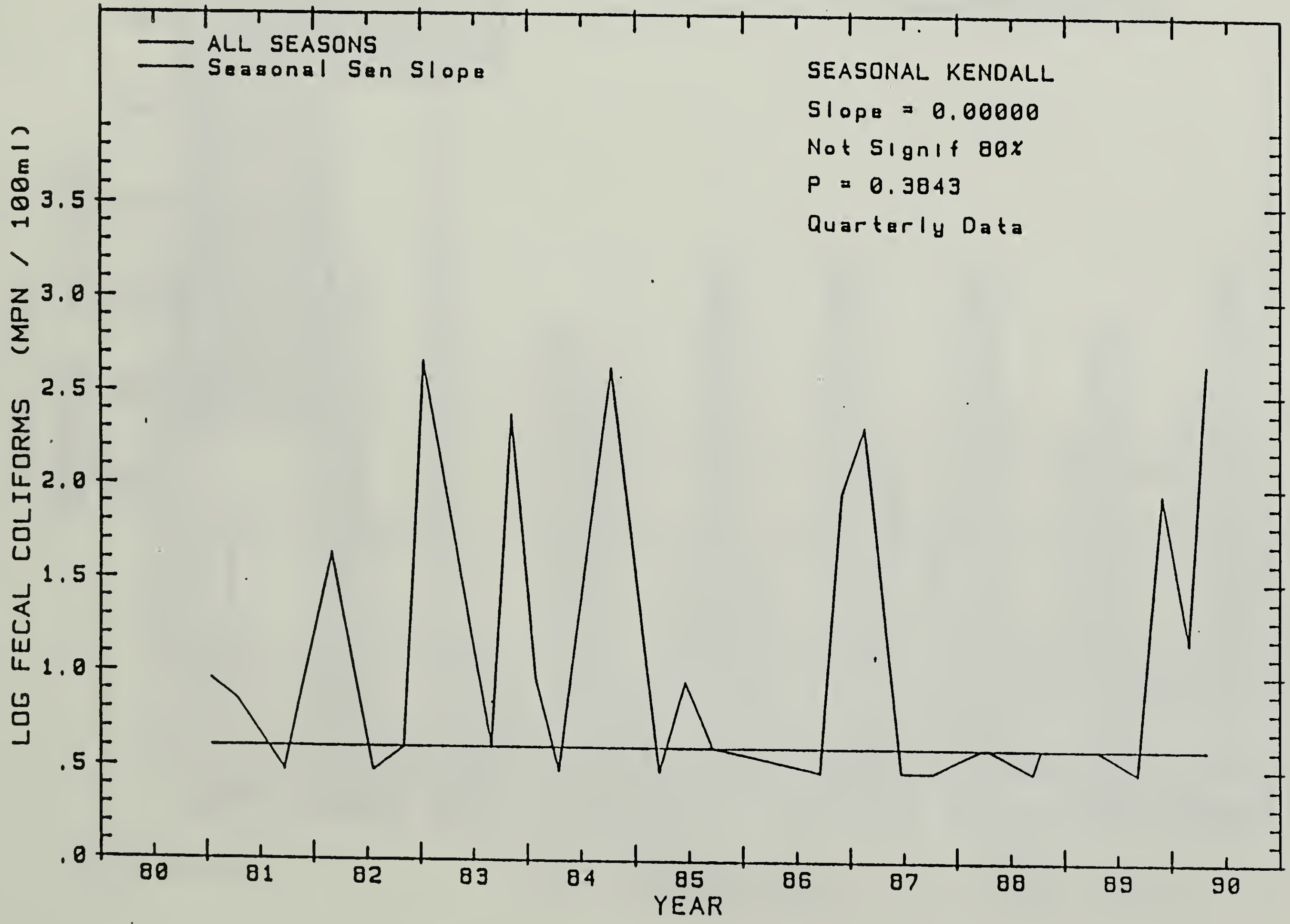
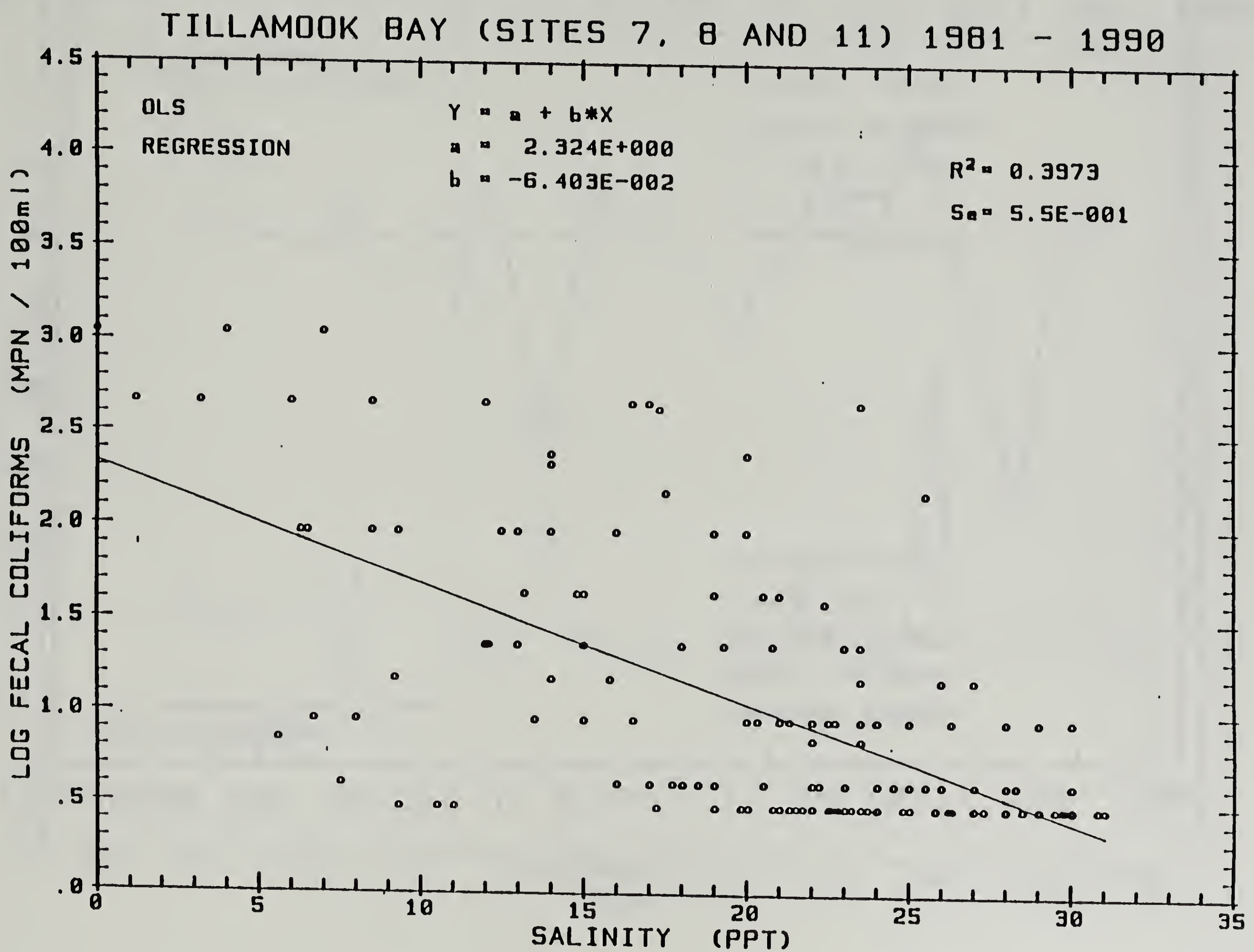


Figure 7.3-4



TILLAMOOK BAY (SITES 7, 8 AND 11) 1981 - 1990
OLS
REGRESSION
Y = a + b*X
a = 2.324E+000
b = -6.403E-002
R² = 0.3973
Se = 5.5E-001
LOG FECAL COLIFORMS (MPN / 100ml)
SALINITY (PPT)
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
.5
.0
0
5
10
15
20
25
30
35

Figure 7.3-5

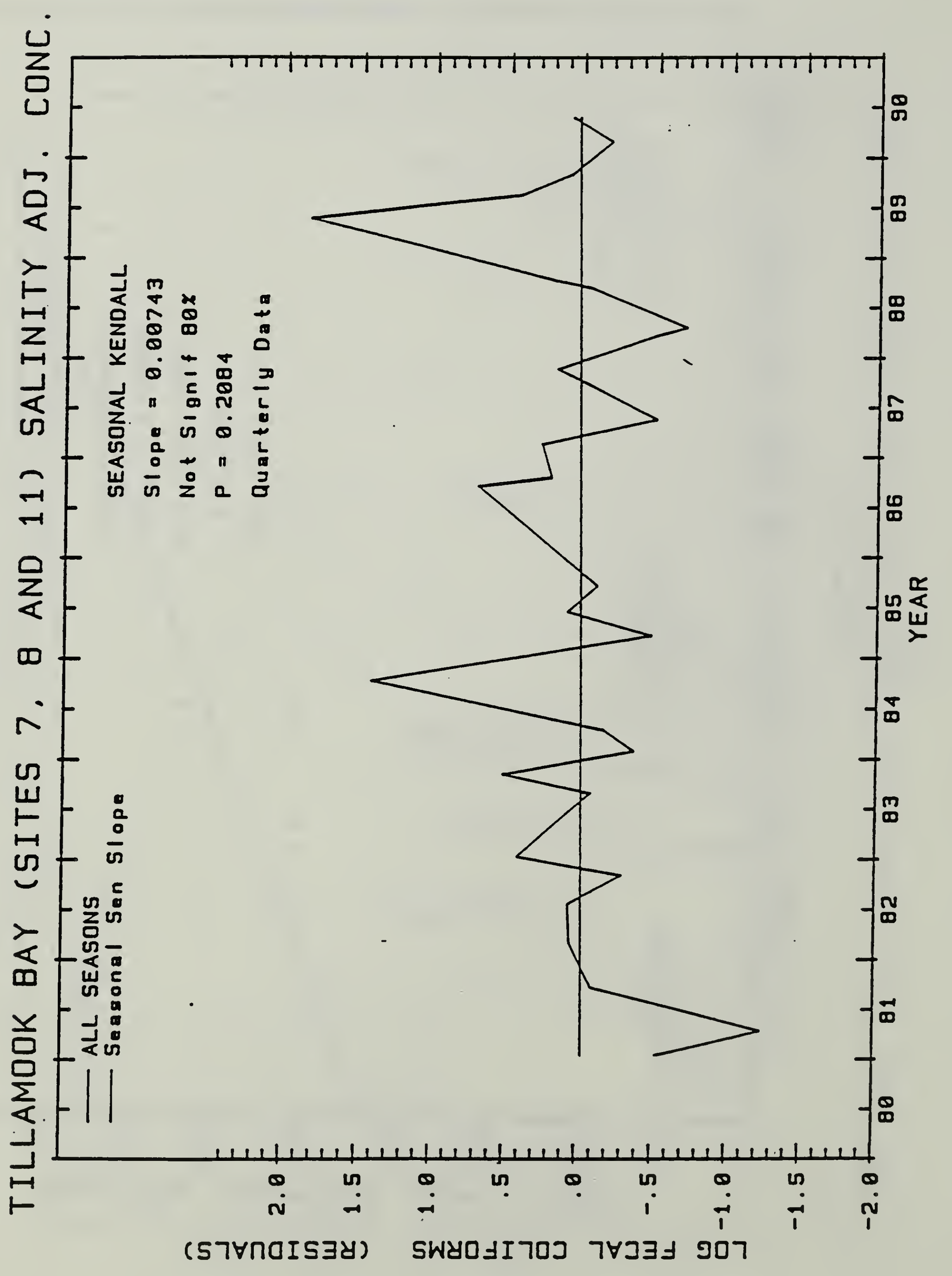

TILLAMOOK BAY (SITES 7, 8 AND 11) SALINITY ADJ. CONC.
ALL SEASONS
Seasonal Sen Slope
SEASONAL KENDALL
Slope = 0.00743
Not Signif 80%
P = 0.2084
Quarterly Data
LOG FECAL COLIFORMS (RESIDUALS)
2.0
1.5
1.0
.5
.0
-.5
-1.0
-1.5
-2.0
80
81
82
83
84
85
86
87
88
89
90
YEAR

Figure 7.3-6

TILLAMOOK BAY (SITES 2, 3, 4, AND 10) SALINITY ADJ. CONC.

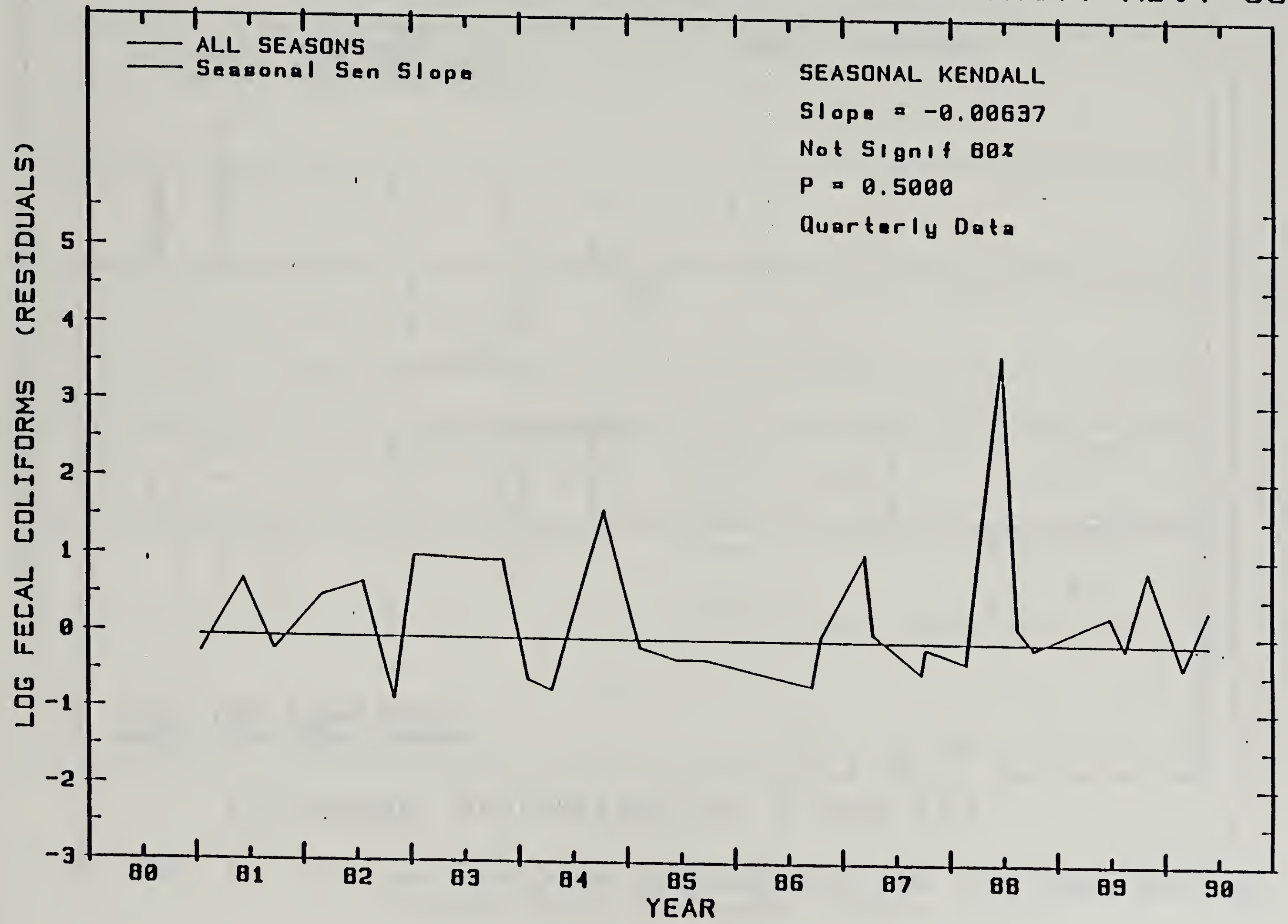
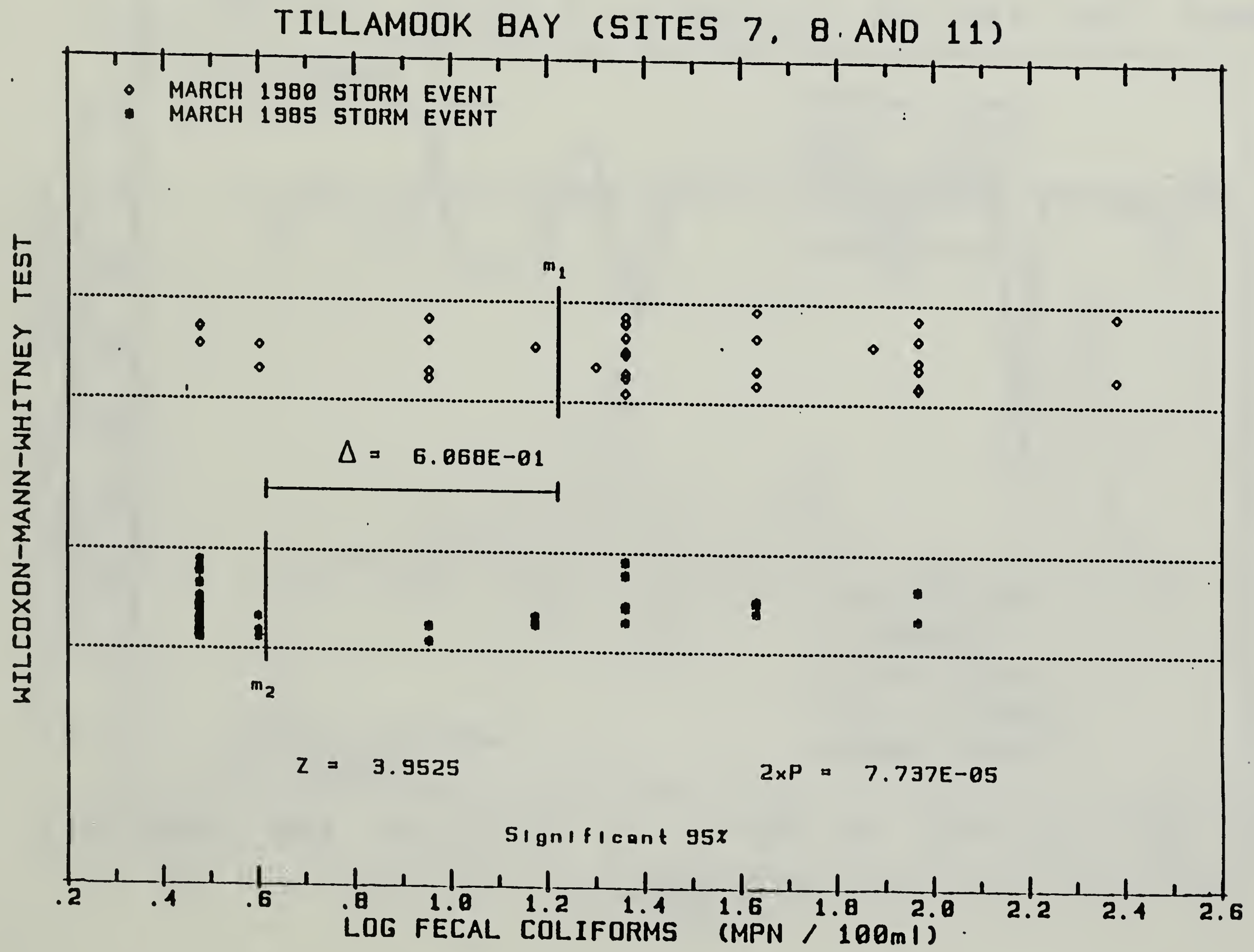


Figure 7.3-7



TILLAMOOK BAY (SITES 7, 8 AND 11)
MARCH 1980 STORM EVENT
MARCH 1985 STORM EVENT
WILCOXON-MANN-WHITNEY TEST
m1
m2
Δ = 6.068E-01
Z = 3.9525
2xP = 7.737E-05
Significant 95%
.2
.4
.6
.8
1.0
1.2
1.4
1.6
1.8
2.0
2.2
2.4
2.6
LOG FECAL COLIFORMS (MPN / 100ml)

Figure 7.3-8

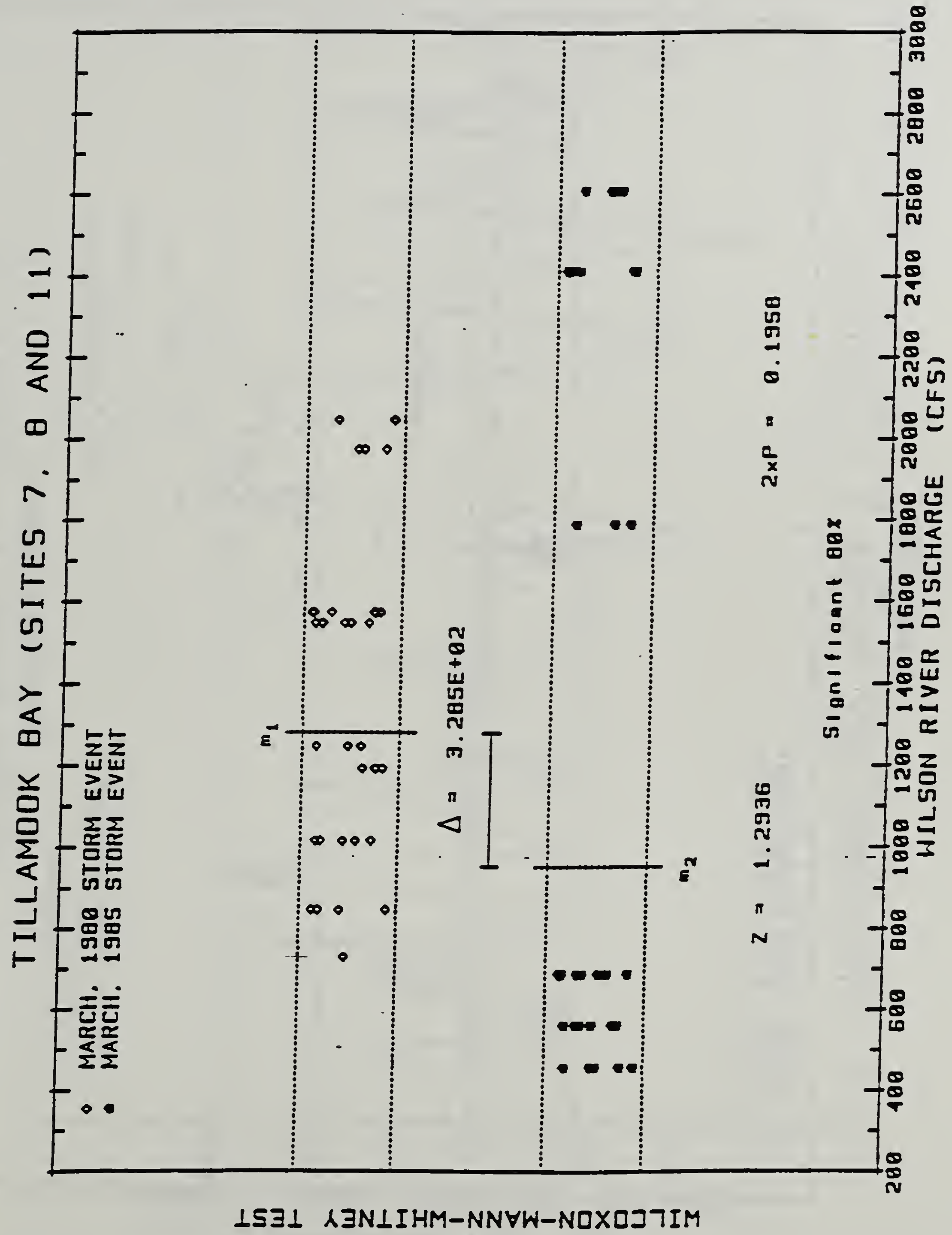

TILLAMOOK BAY (SITES 7, 8 AND 11)
MARCH, 1980 STORM EVENT
MARCH, 1985 STORM EVENT
m1
m2
Δ = 3.285E+02
Z = 1.2936
2xP = 0.1950
Significant 80%
200
400
600
800
1000
1200
1400
1600
1800
2000
2200
2400
2600
2800
3000
WILSON RIVER DISCHARGE (CFS)
WILCOXON-MANN-WHITNEY TEST

Figure 7.3-9

TILLAMOOK BAY (SITES 7, 8 AND 11)

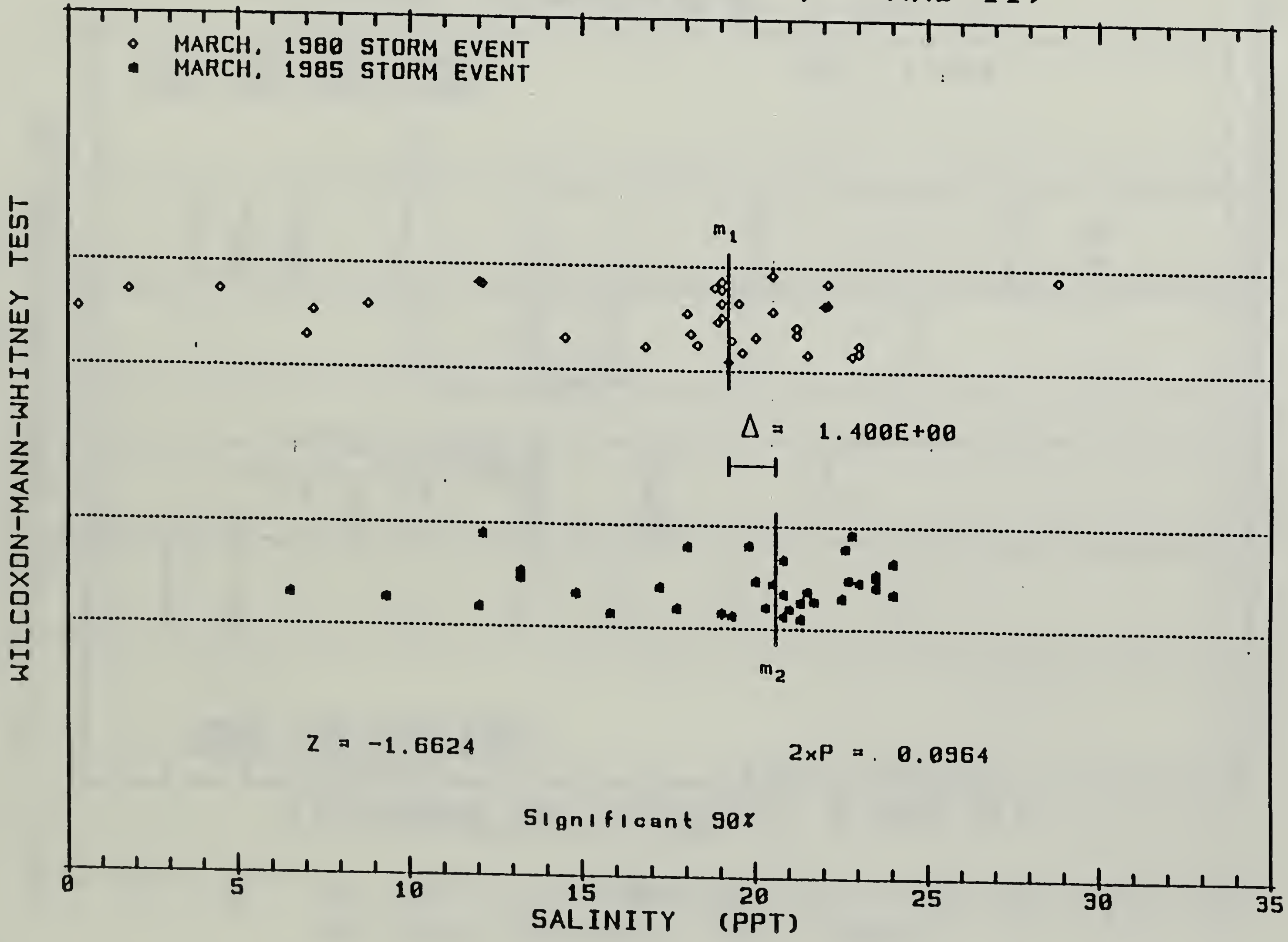


Figure 7.3-10

WILSON RIVER AT HIGHWAY 101

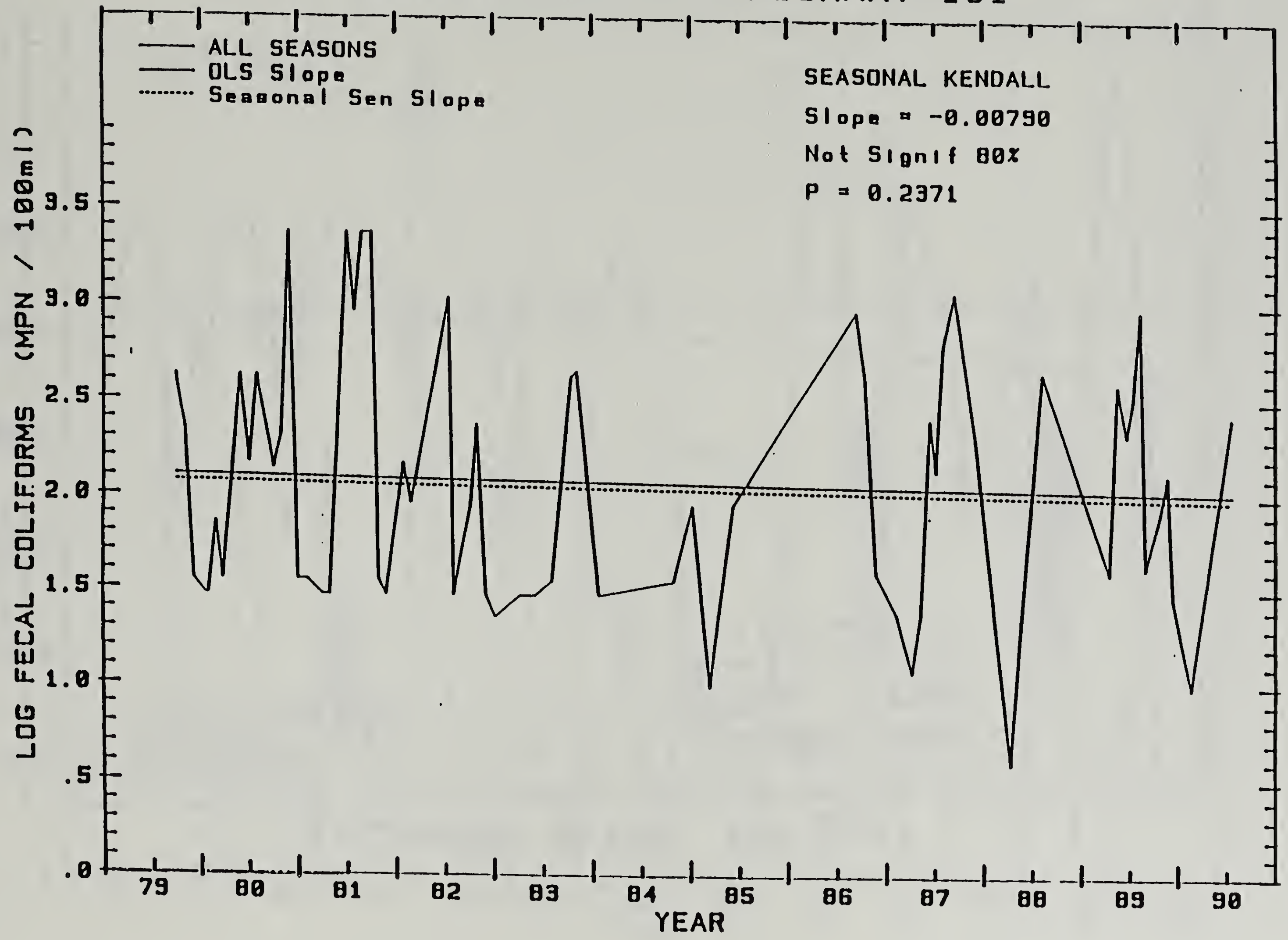
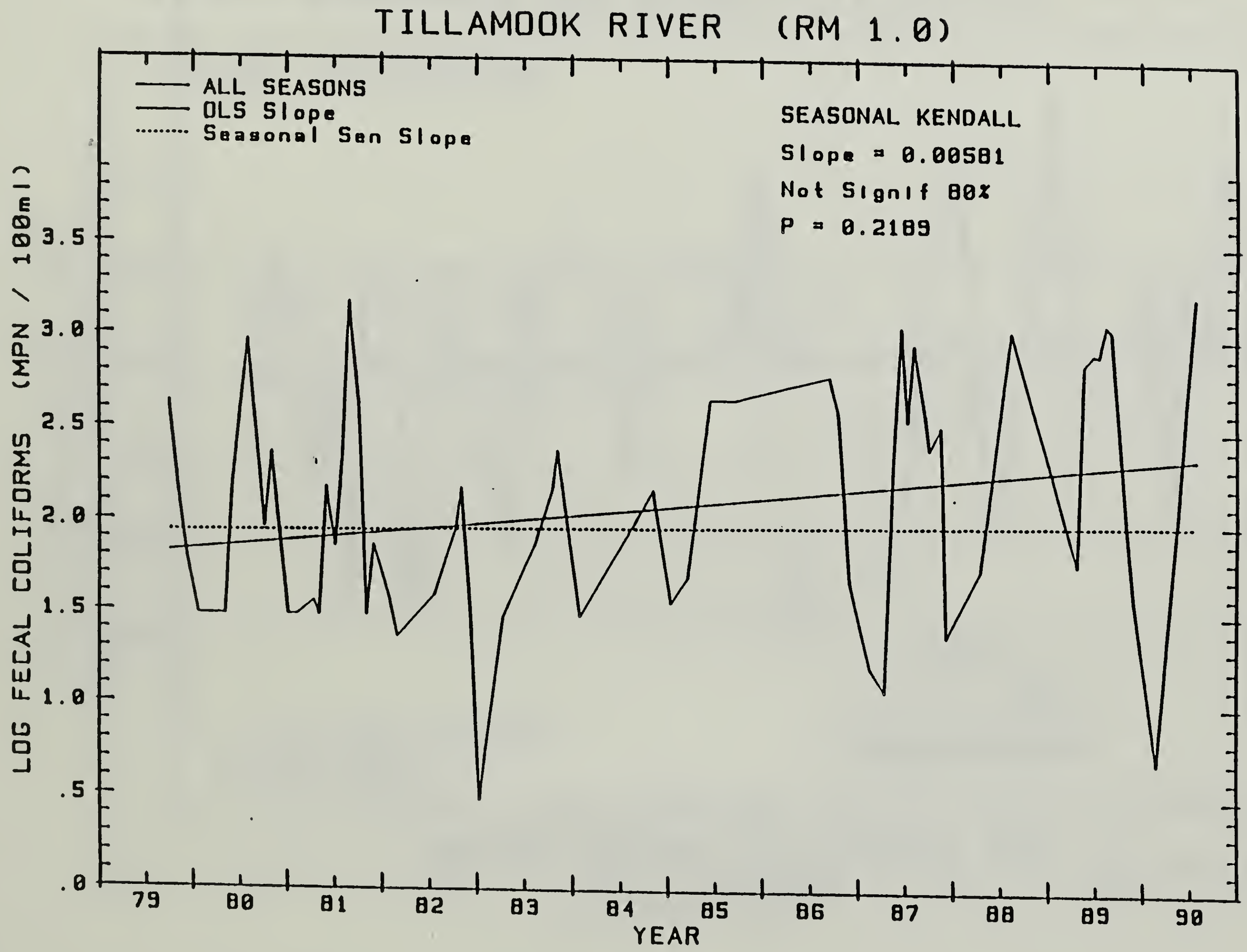


Figure 7.3-11



TILLAMOOK RIVER (RM 1.0)
ALL SEASONS
OLS Slope
Seasonal Sen Slope
SEASONAL KENDALL
Slope = 0.00581
Not Signif 80%
P = 0.2189
LOG FECAL COLIFORMS (MPN / 100ml)
3.5
3.0
2.5
2.0
1.5
1.0
.5
.0
79
80
81
82
83
84
85
86
87
88
89
90
YEAR

Figure 7.3-12

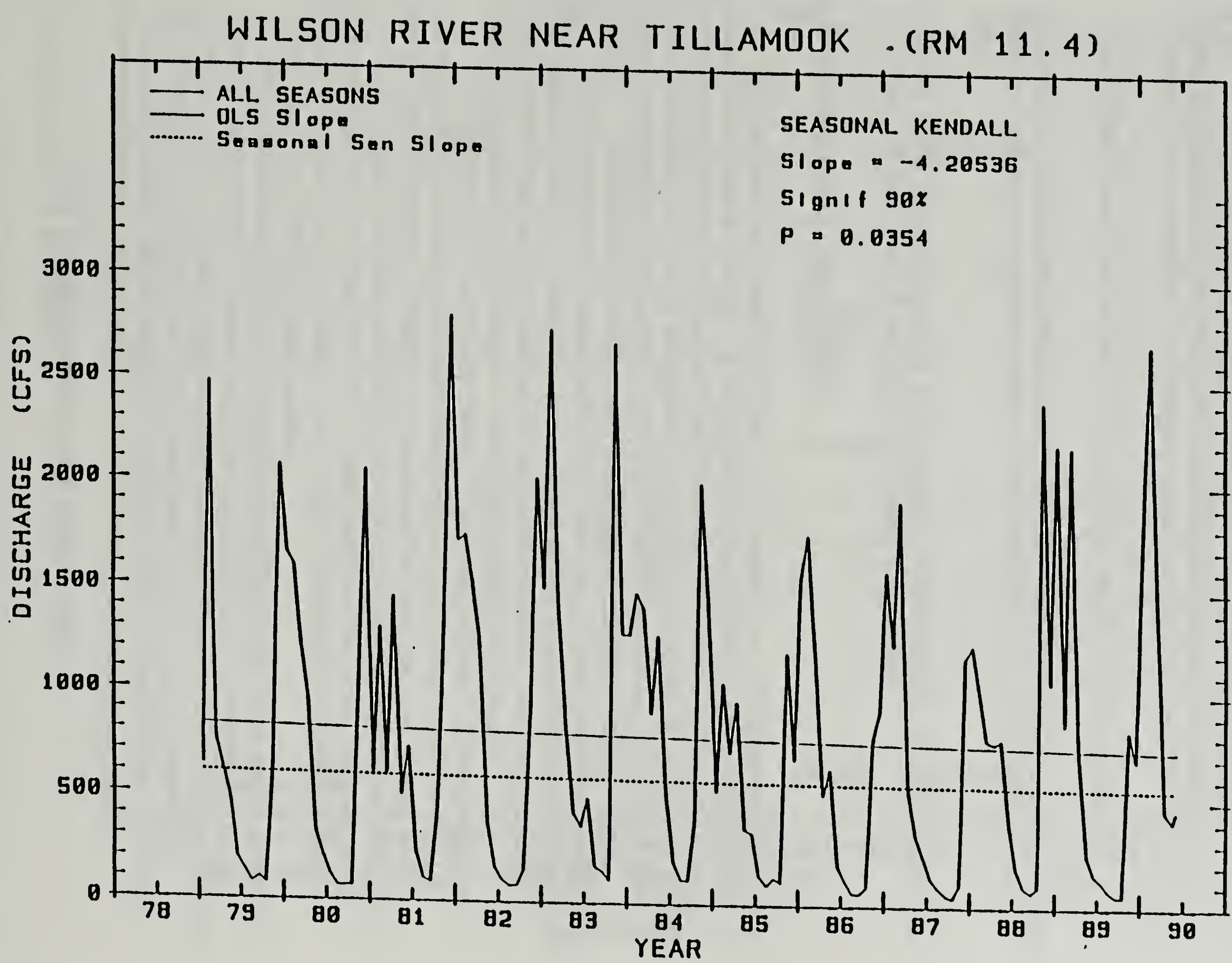
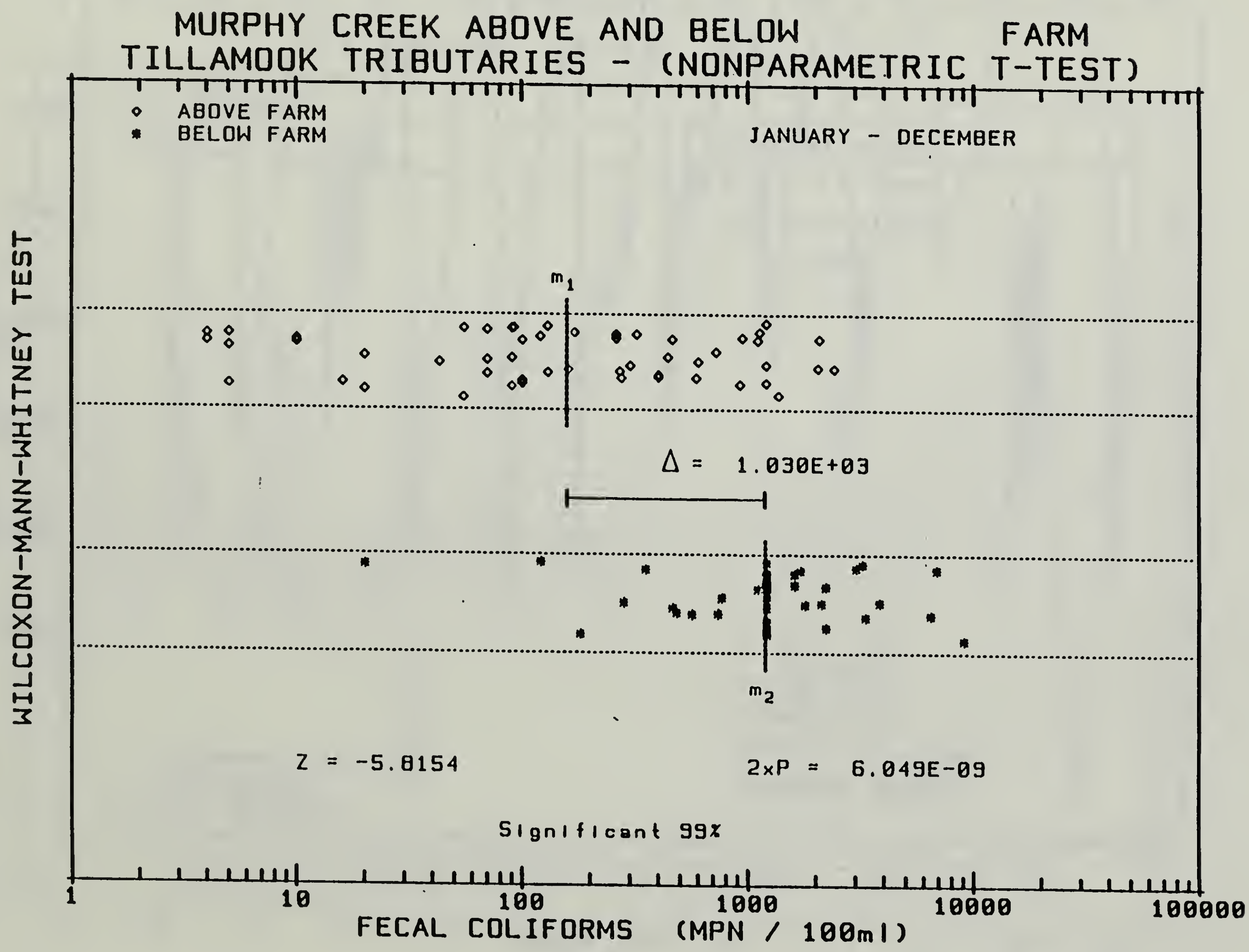

WILSON RIVER NEAR TILLAMOOK .(RM 11.4)
ALL SEASONS
OLS Slope
Seasonal Sen Slope
SEASONAL KENDALL
Slope = -4.20536
Signif 90%
P = 0.0354
DISCHARGE (CFS)
0
500
1000
1500
2000
2500
3000
78
79
80
81
82
83
84
85
86
87
88
89
90
YEAR

Figure 7.3-13



MURPHY CREEK ABOVE AND BELOW FARM
TILLAMOOK TRIBUTARIES - (NONPARAMETRIC T-TEST)
ABOVE FARM
BELOW FARM
JANUARY - DECEMBER
m1
Δ = 1.030E+03
m2
Z = -5.8154
2xP = 6.049E-09
Significant 99%
WILCOXON-MANN-WHITNEY TEST
1
10
100
1000
10000
100000
FECAL COLIFORMS (MPN / 100ml)

8.0 Water Quality - Land Use Data Analysis

8.1 Findings

- The influence of BMPs on water quality is still inconclusive even though water quality improvements have likely occurred in Tillamook Bay.

- Missing data such as river levels and flood stage conditions in the basin play an important role in specifying fecal coliform levels that may influence the role of BMPs.

- Fecal coliform is only an indicator measure of the health of Tillamook Bay.

- Limited and inconsistent sampling data prevent an adequate statistical analysis. More frequent and regular sampling would improve the ability to conduct future data analyses.

- While it would be useful to relate BMP activities to water quality, the existing data and short time series do not allow strong conclusions to be drawn.

8.2 Background and Setting

The Tillamook Bay watershed is fed by five major rivers. Although the major land use in the drainage is forestry, the floodplains are used primarily for agricultural purposes, nearly all of it associated with dairy farming. The Tillamook Bay area is also a popular recreation and tourist destination, providing opportunities for freshwater and bay fishing, clam digging, and boating. Commercial shellfish fisheries are also important to the region. The climate is distinctly marine with high, sometimes intense, rainfall.

The combination of concentrated dairy farming, high rainfall events, and periodic river flooding results in occasionally severe water quality problems in the rivers and bay, as exposed animal manure is washed or leached into streams. High fecal coliform bacteria counts have led to closure of oyster bed harvests on occasion.

The Tillamook Bay Rural Clean Water Project was initiated to correct non-point source pollution problems associated with the high concentration of dairies in the Tillamook Bay watershed. The Soil Conservation Service used the mandate of the RCWP to engage in contracts with dairy operators to implement appropriate Best Management Practices in a timely manner. These practices (described in 3.3) would be applied individually or in combination, and serve to manage and otherwise prevent manure runoff from entering water courses.

The effectiveness of BMP implementation in reducing non-point source pollution is important to determine. However, its significance is difficult to measure due to the complex interaction of environmental factors and other influences affecting water quality. Nevertheless, it is useful to identify the determinants of water quality levels in the Tillamook Bay region, and to assess the influence of BMP implementation on overall water quality in the rivers and bay.

8.3 Approach to Analysis

Fecal coliform bacteria has been identified as the primary water quality problem in Tillamook Bay. Dairy farms are the primary source of this bacteria, particularly those with poor manure storage facilities and disposal practices. Other potential sources of the bacteria include the region's wastewater treatment plants and failing domestic on-site septic tank systems.

Fecal coliform measurements have been made at 31 sites in the Tillamook Bay area, including 15 sites on the Miami, Kilches, Wilson, Trask, and Tillamook Rivers, and 16 sites in the bay. Measurements have been made since 1960 at the river sites (although usually just once or twice annually the first decade), and since 1976 in the bay sites. BMP implementation began in 1980.

Two river sites and two bay sites were selected as representative for this analysis: T4A on the Tillamook River (located at the Highway 101 bridge crossing on the Tillamook River), W13 on the Wilson River (at the Highway 101 bridge crossing on the Wilson River), and B02 and B12 in eastern Tillamook Bay. Each site was analyzed independently, but the approach used was identical for all sites. Fecal coliform measurements by date are displayed in figures 1 through 4.

FC levels (with associated dates and times of measurement) formed the set of observations. For each observation, additional data were collected or computed as independent variables affecting the FC observation. Among these were the set of BMPs in effect at the time of the observations. However, as BMPs were generally not put in place until 1980, it is possible to compare the influence on FC of BMPs before and after implementation. The hypothesis tested is whether the implementation of BMPs has reduced the occurrence of fecal coliform levels in the rivers and bay of the Tillamook Bay drainage.

8.4 Variables and Data Sources

Variables selected for this analysis were chosen on the basis of their potential relevance as factors affecting water quality in the basin, and availability of data. In this section these variables are outlined and data sources are identified. Expected direction of influence or relationship (sign) is also noted for each.

As stated, fecal coliform level is the dependent variable in all equations. The remaining variables are independent variables expected to affect FC level.

8.4.1 Best Management Practices

The Soil Conservation Service has maintained detailed records on participating dairies in the Tillamook drainage and details of BMPs applied to dairy operations. For each water quality measurement site, therefore, it was possible to determine what quantity of practices were considered "in effect" on a particular date for all dairies upriver of the site. BMPs, quantity units, and variable names were used as follows:

Best Management Practice	Units	Variable
Pasture and hayland managed	Acres	ACRES
Gutters on roofs	Linear feet	GUTTERS
Liquid storage	Cubic feet	LIQUID
Waste management systems	Number	MANAGE
Roofs over slabs	Square feet	ROOFS
Solid storage	Cubic feet	SOLID
Manure fertilizer managed	Tons	MANURE

These data were merged with the FC observations by determining the accumulated total units of each BMP which were in effect at the time of measurement. For example, a water quality measurement on March 20, 1982 might have 3 waste management systems and 1,000 managed acres of pastureland as practices that were "in effect" as of that date.

Some practices (such as pasture and hayland management) are installed alone, while others (gutters and roofs) often are installed in combination. With the existing data, it was not possible to distinguish whether double-counting or an overestimate of practices in effect is occurring.

Each BMP is, of course, designed to reduce fecal coliform count. The expected signfor all variables is negative.

8.4.2 Precipitation

Precipitation in the 48-hours preceding the observed measurement were included for two weather stations in the vicinity: Tillamook 12ESE (PRECIP12) and Tillamook 1W (PRECIP1). Records from the former were included in the river sites and the latter in the bay sites. These variables are expected to be positively related to fecal coliform level.

8.4.3 Wilson River Discharge

Mean daily discharge levels (in cubic feet per second) were available for observations of 1979 through 1988 on the Wilson River. These data were incorporated (as WILSON) in a limited-observation trial for the appropriate period on river site W13, and were expected to be positively related to FC level.

8.4.4 Summer Tourist Season

As noted in section 2.2, Tillamook County population has remained relatively stable during the past decade. A much greater flux can be noted by the sizable and seasonal tourist population. For example, in 1990 some 800,000 visitor-days were made to Tillamook County [Vicki Goodman, Tillamook County Economic Development, personal communication]. Data collected from the Tillamook County Creamery Association on creamery sales for 1989 and 1990 confirmed the significance of the summer tourist season (June, July, August, and September). A high tourist population may contribute to measured FC levels.

For each FC observation in the bay sites a dummy variable (SUMMER) was included to represent the four summer months, and was expected to be positive in sign.

8.4.5 Fall Season

A combination of events takes place in the autumn months of September, October, and November which can have a potentially significant effect on fecal coliform count. Following the mostly dry summer months when stream levels are at their lowest, the rainy season begins in earnest. One effect of this is to set into place the transport capability of recently spread manure from fields into waterways.

Another important factor is that manure storage units are being emptied in preparation for the winter period, when such activities are more severely limited. The additional manure, often uncovered, provides a source of greater FC levels.

A particular attraction to the rivers in Tillamook County is fishing for Chinook salmon in the fall months (September, October, and November). During these months the number of riverside recreationists is substantially higher than other times, and may contribute to measured FC levels.

A dummy variable (AUTUMN) for these three months was included in the river and bay sites to represent this seasonal effect.

8.5 Regression Results and Analysis

8.5.1 Tillamook River Site T4A.

Site T4A resulted in 111 observations, including 41 with no best management practices in effect ("non-practice set") and 70 with practices ("with-practices set").

An OLS regression of the non-practice set, with independent variables PRECIP12 and AUTUMN produced results with a correlation coefficient (r^2) of .58, but with only PRECIP12 significant at the .01 level. (In the equations that follow, values in parentheses are t-statistics. For each variable, * indicates significance at the .10 level, ** at the .05 level, and *** at the .01 level.)

```
FC = 90.025 + 659.975 AUTUMN + 648.267 PRECIP12
      (0.18)     (1.29)           (7.26)
                                    ***

r² = 0.582      38 degrees of freedom
```

A regression of the with-practices set, containing independent variables for all BMPs as well as PRECIP12 and AUTUMN produced results with $r^2 = .18$. Just one variable (GUTTER) was significant at the .10 level, and even PRECIP12 was not found to be significant. However, an examination of the variance-covariance matrix showed the Best Management Practice variables to be highly correlated with one another. This indicates that only some composite variable accounting for all BMPs should be included in the equation. While this would not improve the equation fit (i.e., there are still some missing variables), a better correlation between BMPs and FC is possible.

```
FC = -529.694 + 3.283 ACRES + 0.267 GUTTER - 0.002 LIQUID
      (-0.72)    (0.48)         (1.39)         (-0.05)
                                  *

  + 0.041 ROOFS - 0.014 SOLID - 0.024 MANURE - 164.440 AUTUMN
    (0.77)         (-0.81)        (-0.07)          (-0.74)

  + 114.451 PRECIP12
    (1.10)

r² = 0.184      61 degrees of freedom
```

While GUTTER was found significant, it was of the incorrect sign. This may be a product of the multicolinearity among BMP variables. PRECIP12 was of the correct sign.

8.5.2 Wilson River Site W13

A total of 176 observations were included in site W13, including 74 with no BMPs and 102 with practices in effect. A Wilson River discharge reading were included in 37 observations of the non-practice set and 82 of the with-practices set.

The non-practice sets, both with and without the WILSON variable, initially had low r^2 values of .03 and .09, respectively. PRECIP12 in the first equation, and WILSON in the second were the only variables significant at the .10 level. However, when a single outlier observation (with an FC level of 45,000) was removed, this equation improved substantially. Both PRECIP12 and AUTUMN were found to be significant and of the expected sign.

$$FC = \underset{(0.32)}{70.281} + \underset{\substack{(2.30)\\ **}}{46.660}\ PRECIP12 + \underset{\substack{(5.59)\\ ***}}{490.706}\ AUTUMN$$

$$r^2 = 0.326 \qquad 70 \text{ degrees of freedom}$$

The with-practices set regressions performed about the same as the without-practices set. LIQUID, SOLID, MANURE, PRECIP12, and AUTUMN were all significant at the .10 level, with an r^2 of .25. Of the subset containing Wilson River readings, r^2 = .39 and PRECIP12, AUTUMN, and WILSON were significant at the .10 level. Again, the BMP variables were highly correlated.

$$FC = \underset{(-0.50)}{-223.679} - \underset{(-0.28)}{0.404}\ ACRES - \underset{(-0.14)}{0.028}\ GUTTER + \underset{\substack{(2.87)\\ ***}}{0.022}\ LIQUID$$

$$- \underset{(-0.05)}{6.590}\ MANAGE + \underset{(1.04)}{0.018}\ ROOFS + \underset{\substack{(1.79)\\ **}}{0.011}\ SOLID - \underset{\substack{(-3.19)\\ ***}}{0.273}\ MANURE$$

$$+ \underset{\substack{(3.67)\\ ***}}{153.442}\ PRECIP12 + \underset{\substack{(1.59)\\ **}}{182.972}\ AUTUMN$$

$$r^2 = 0.245 \qquad 92 \text{ degrees of freedom}$$

8.5.3 Tillamook Bay Site B02

Bay site B02 is considered to be influenced by the Tillamook and Wilson River drainages. The site contained 126 observations, with 23 containing no practices and 103 with practices.

The non-practice set had r^2 = .45 using variables PRECIP12, PRECIP1, SUMMER, and AUTUMN. A respecification without PRECIP12 resulted in an r^2 of .42 with PRECIP1 and AUTUMN significant at the .10 level, each with the correct sign.

$$FC = \underset{(0.26)}{155.951} + \underset{\substack{(1.55)\\ *}}{211.091}\ PRECIP1 - \underset{(-0.32)}{145.830}\ SUMMER + \underset{\substack{(3.57)\\ ***}}{2244.049}\ AUTUMN$$

$$r^2 = .424 \qquad 19 \text{ degrees of freedom}$$

The with-practices set had a low r2 of only .17, but with ACRES, GUTTER, STORAGE, MANURE, and PRECIP1 all significant at the .10 level. However, MANURE had the wrong sign. Nevertheless, the BMP variables were highly correlated with one another.

```
FC = 43.732 - 0.588 ACRES - 0.042 GUTTER + 0.001 LIQUID
     (0.13)   (-1.40)       (-2.35)         (0.10)
                 *             **

+ 38.332 MANAGE + 0.002 ROOFS - 0.005 SOLID + 0.041 MANURE
  (0.81)          (0.70)        (-1.69)       (1.99)
                                    **            **

+ 150.709 PRECIP1 - 26.517 SUMMER - 67.653 AUTUMN
  (2.80)            (-0.32)          (-0.80)
   ***

r² = .165   92 degrees of freedom
```

In an effort to improve the equation fit, three outliers observations were removed. The correlation coefficient improved only to .20.

8.5.4 Tillamook Bay Site B12

Bay site B12 contains influences from the Tillamook, Trask, and Wilson Rivers. There were 105 observations, including 32 without practices and 73 with practices.

A regression of without practice observations using PRECIP1, SUMMER, and AUTUMN produced an r^2 of .43, with PRECIP1 and AUTUMN significant at the .01 level.

```
FC = -81.327 + 568.888 PRECIP1 - 146.584 SUMMER + 2846.327 AUTUMN
       (-0.09)   (2.90)            (-0.22)            (4.14)
                  ***                                  ***

r² = 0.426   28 degrees of freedom
```

The with-practice set containing the BMP variables resulted in an r^2 of .39 with just PRECIP1 significant and with high correlation among BMP variables. The removal of a single outlier observation improved the specification, to a correlation coefficient value of .56. In this case, GUTTER and PRECIP1 were significant and had the correct sign, and ROOFS and AUTUMN were significant but had the wrong sign.

```
FC = 156.247 - 0.389 ACRES - 0.042 GUTTER - 0.001 LIQUID
     (0.72)    (-1.15)       (-1.54)        (-0.80)
                                *

+ 53.646 MANAGE + 0.003 ROOFS + 0.001 SOLID + 0.016 MANURE
   (1.16)         (1.35)         (0.04)        (1.27)
                    *

+ 310.516 PRECIP1 + 24.732 SUMMER - 127.307 AUTUMN
   (7.23)            (0.41)          (-2.11)
    ***                                ***

r² = 0.558   61 degrees of freedom
```

8.6 Analysis and Conclusions

As indicated by the results in section 8.4 for the four area sites analyzed, accurate specification of the determinants of water quality in Tillamook Bay remains somewhat elusive. None of the specified equations performed particularly well, indicating that fecal coliform level is influenced by more factors than the current data can explain. Nevertheless, some conclusions can be drawn from the analysis.

That precipitation is a most important influence on fecal coliform level is not surprising. It was significant in all equations, verifying that high rainfall is associated with high fecal coliform. However, in each of the four sites there were other factors (not all specified explicitly) which play an important role; many observations had simultaneously high precipitation and low FC level, and vice versa (see figures 5 through 8).

The seasonal variable AUTUMN provided some mixed results. It showed a positive correlation in the Wilson River site, and a weak association in the Tillamook River site. A significant and mixed positive and negative influence was also found in the two bay sites. This suggests that a seasonal effect can be noted but may not be properly captured by this variable.

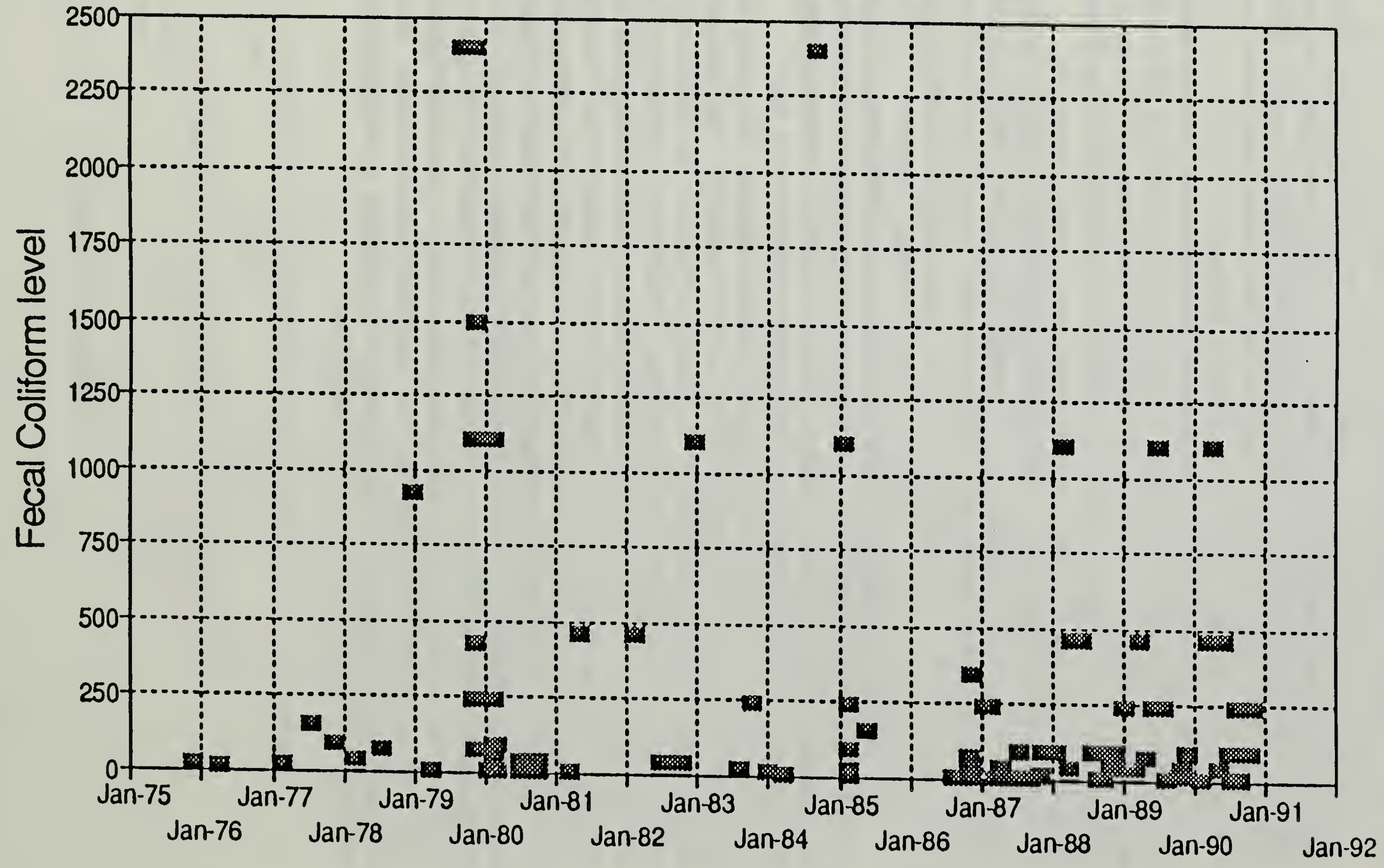
The role of the SUMMER seasonal variable (as specified in these equations) was not determined to be directly relevant to the two sites analyzed. These sites are located in the eastern portion of the bay and may be less subject to human population influence as elsewhere. Data limitations prevented further analysis of this point.

The influence of BMPs on water quality is inconclusive. The river site and one bay site equations were not well-specified, while the other bay site was fairly well-specified. Nevertheless, each equation had one or more BMP variable as significantly correlated with FC level. Mixed results on signs of these variables were probably the result of multicolinearity. Data conversion difficulties (in terms of associating each BMP into equivalent manure-control units) hampered efforts to respecify BMP variables into a single practice variable, which would correct the multicolinearity problems.

Missing variables which may play an important role in specifying fecal coliform levels (and which could influence the role of BMPs) include river levels for all river site observations, and flood stage information. This would particularly be the case for explaining the outlying (very high FC level) observations. It is possible that high FC levels can be directly associated with rivers exceeding the flood stage, allowing manure to directly enter water courses. While precipitation may be a close approximation, river level and flood stage may improve the estimation.

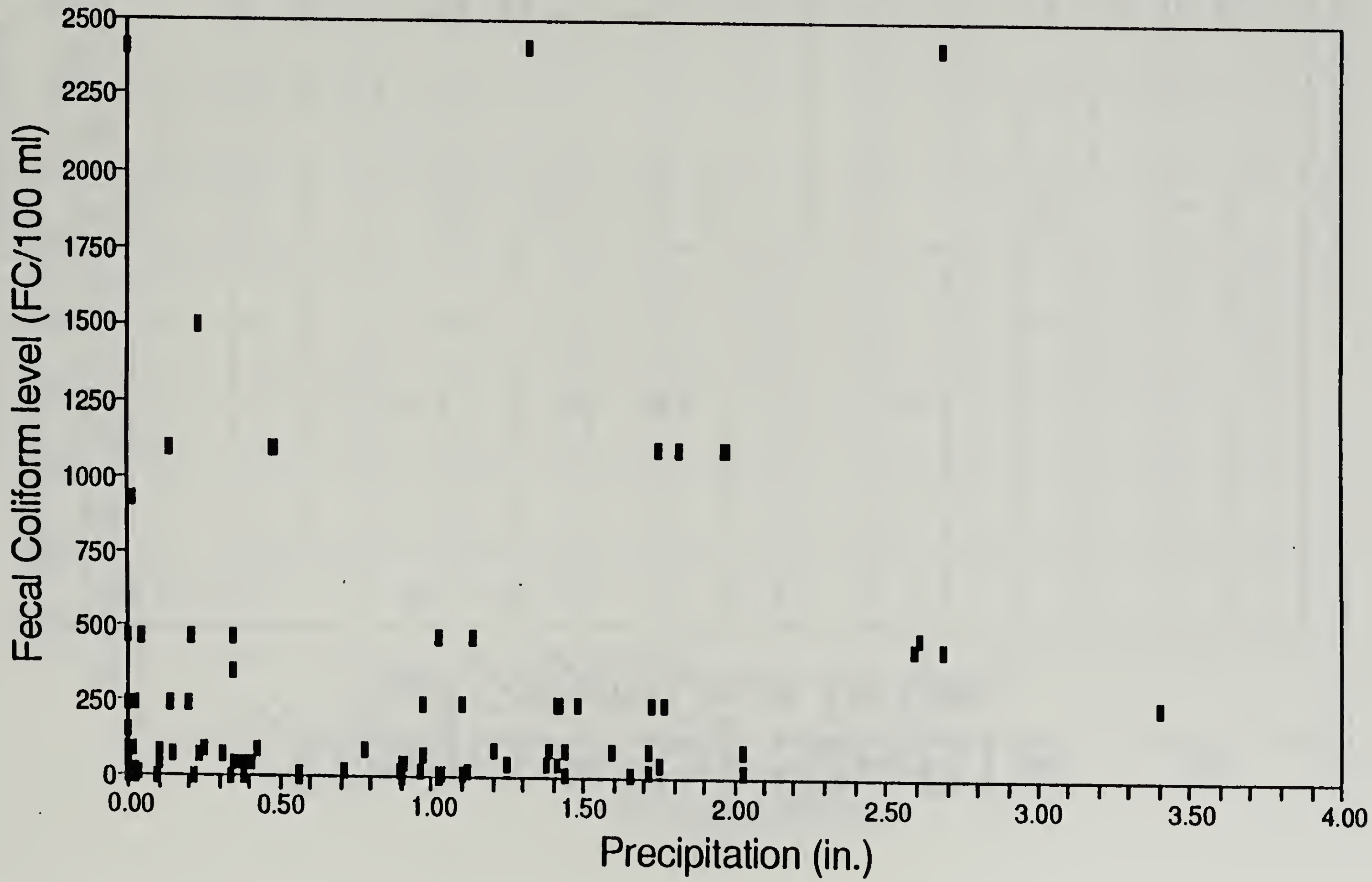
Tillamook Bay Site B02

Fecal Coliform Count, By Date



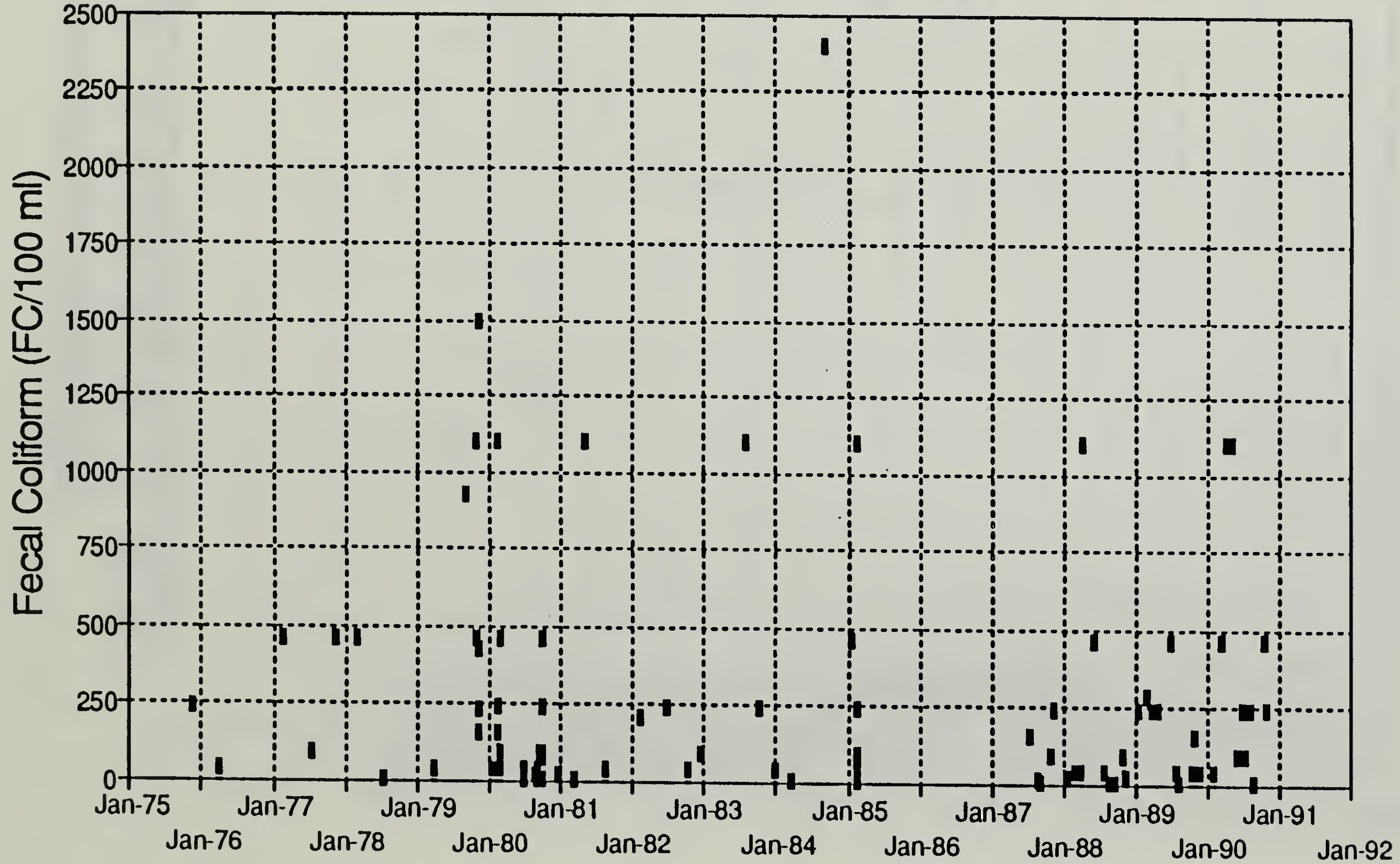
Tillamook Bay Site B02

Fecal Coliform vs. Precipitation



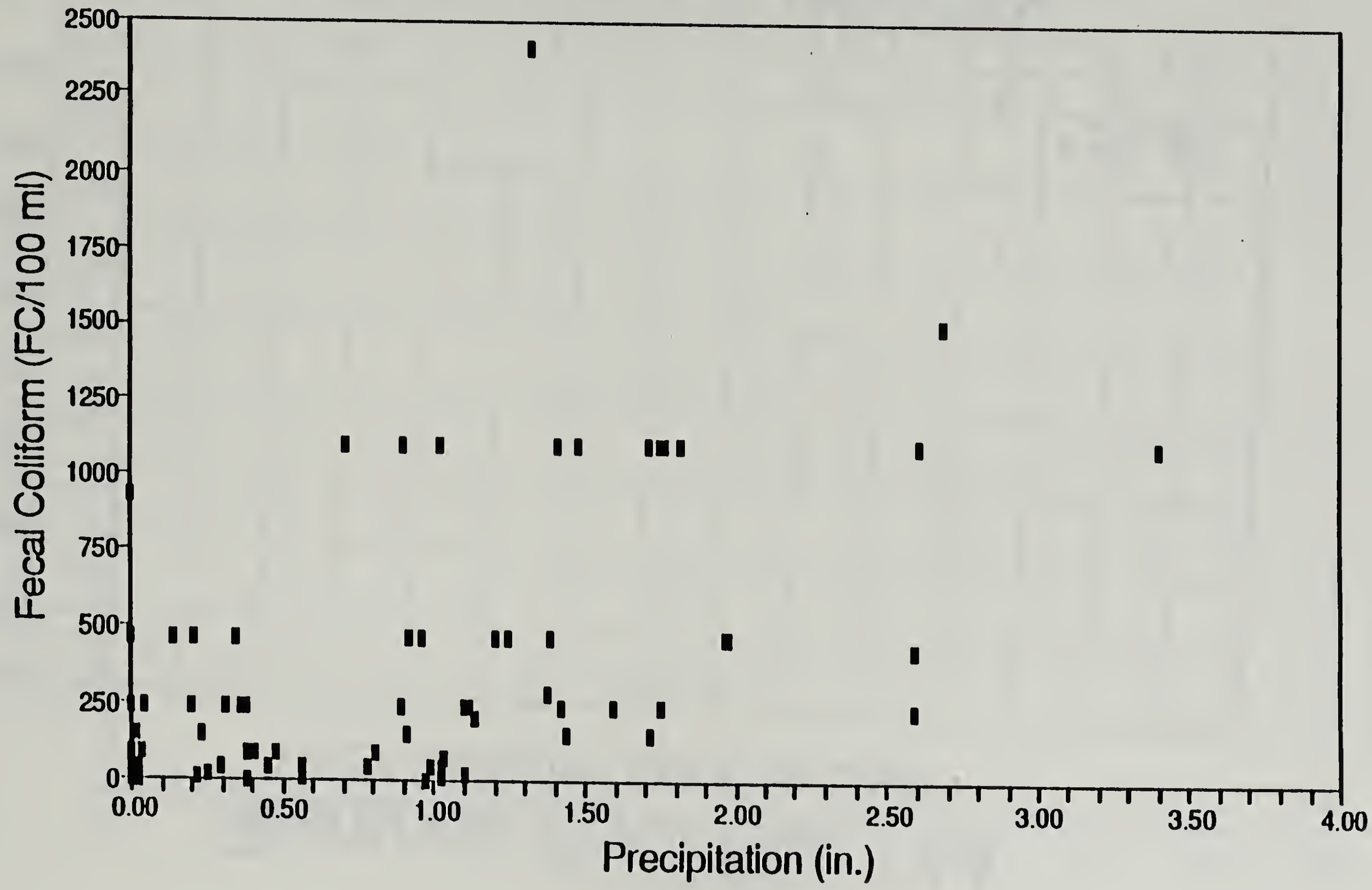
Tillamook Bay Site B12

Fecal Coliform Count, By Date



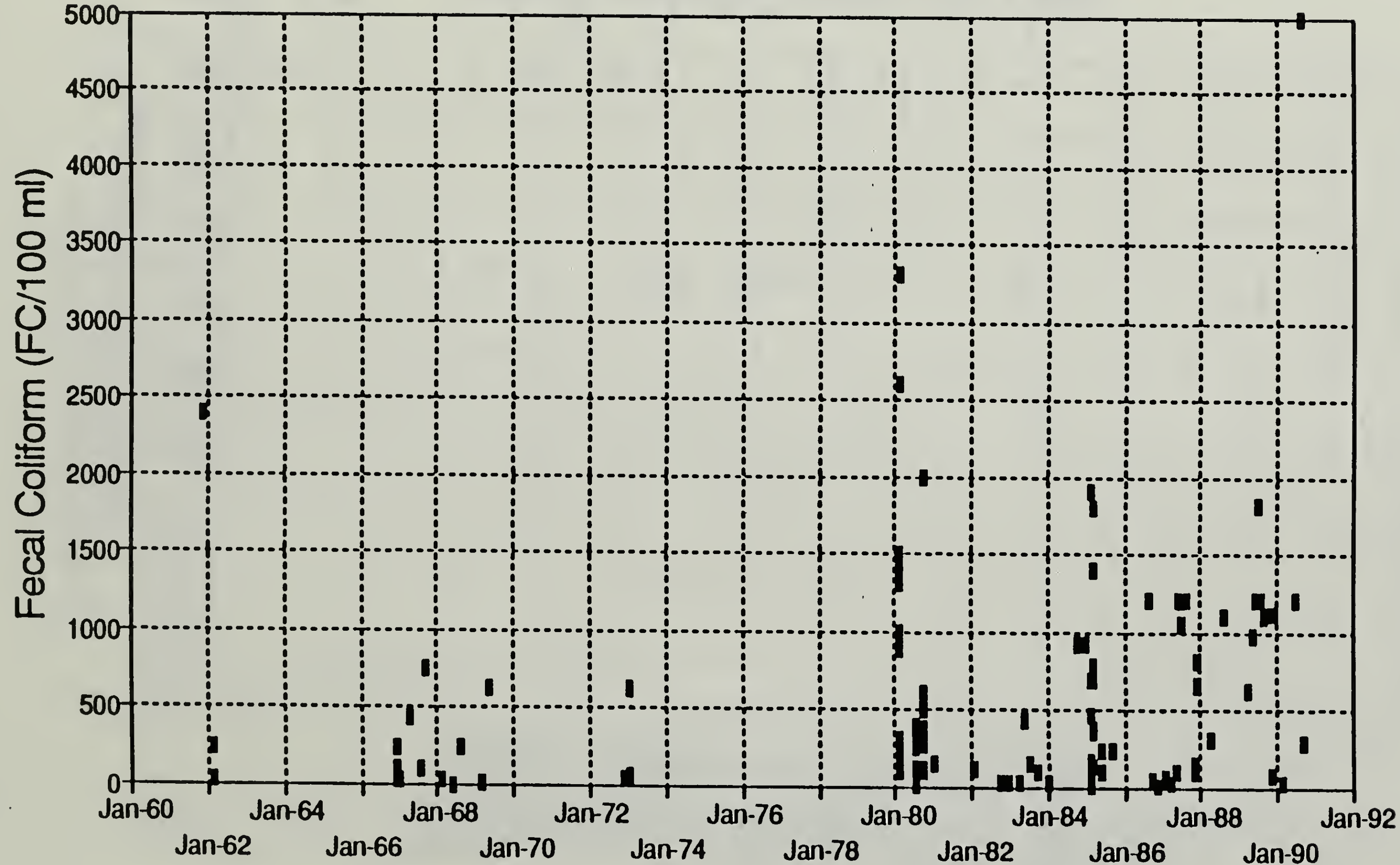
Tillamook Bay Site B12

Fecal Coliform vs. Precipitation



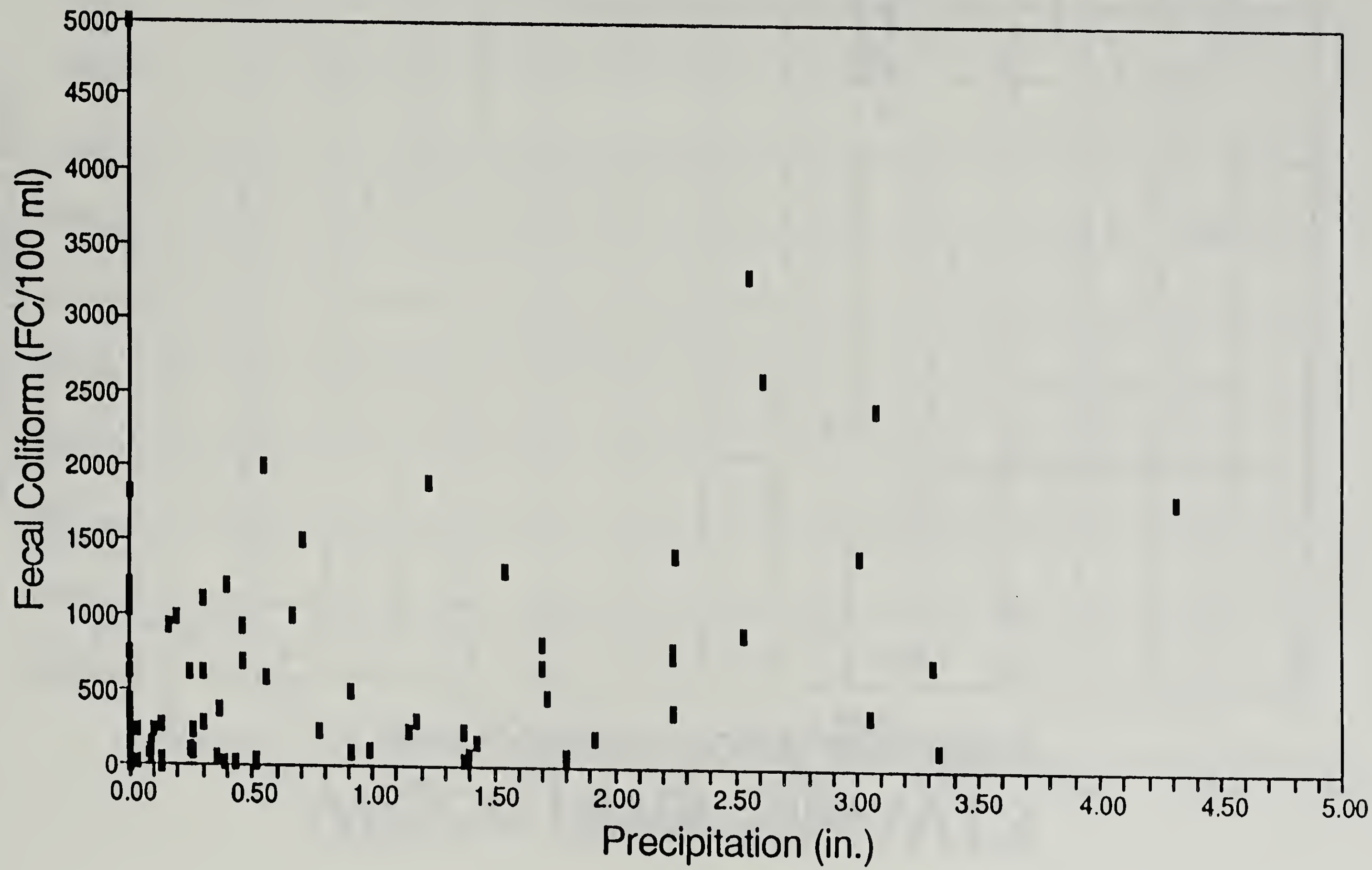
Tillamook River Site T4A

Fecal Coliform Count, By Date



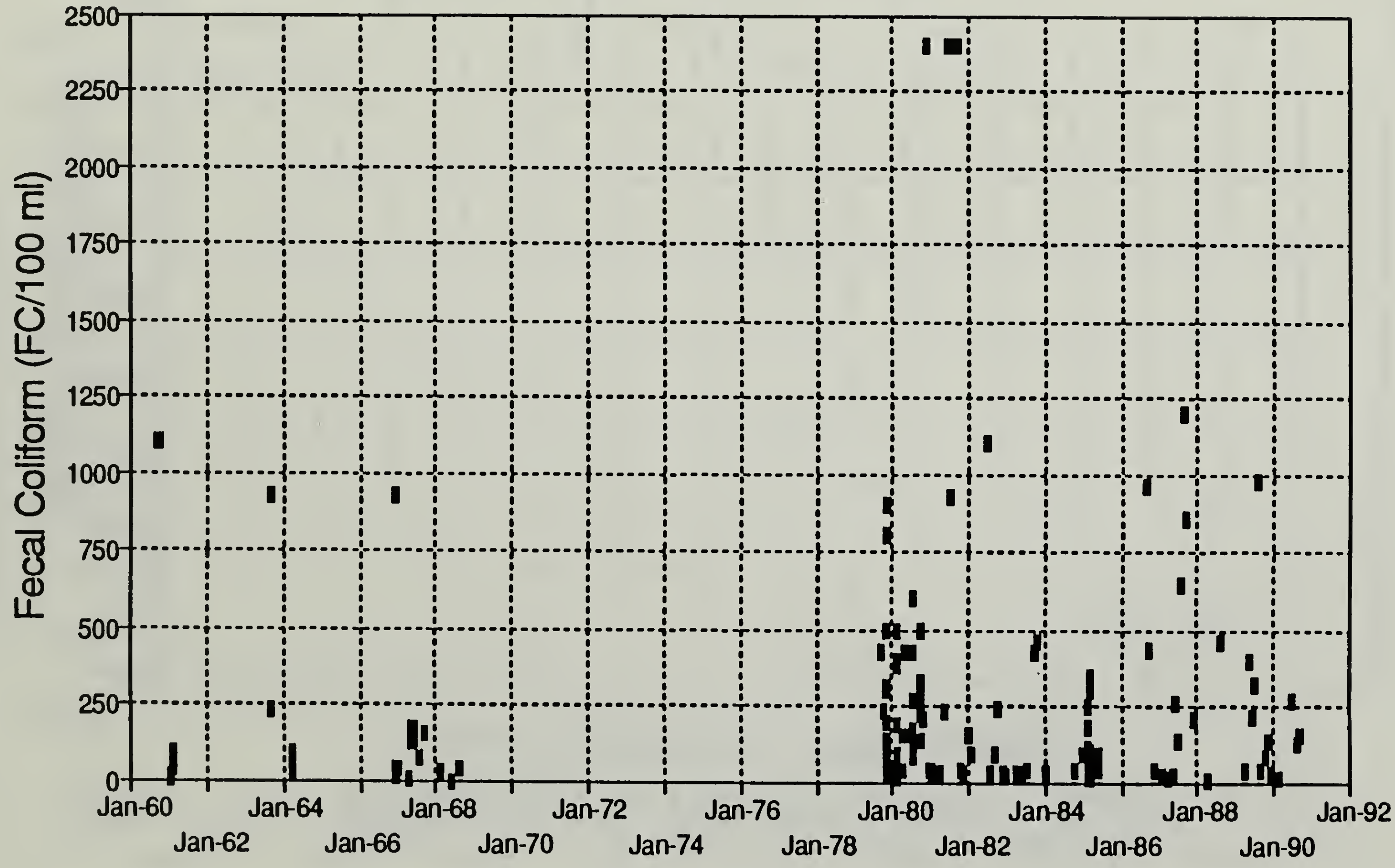
Tillamook River Site T4A

Fecal Coliform vs. Precipitation



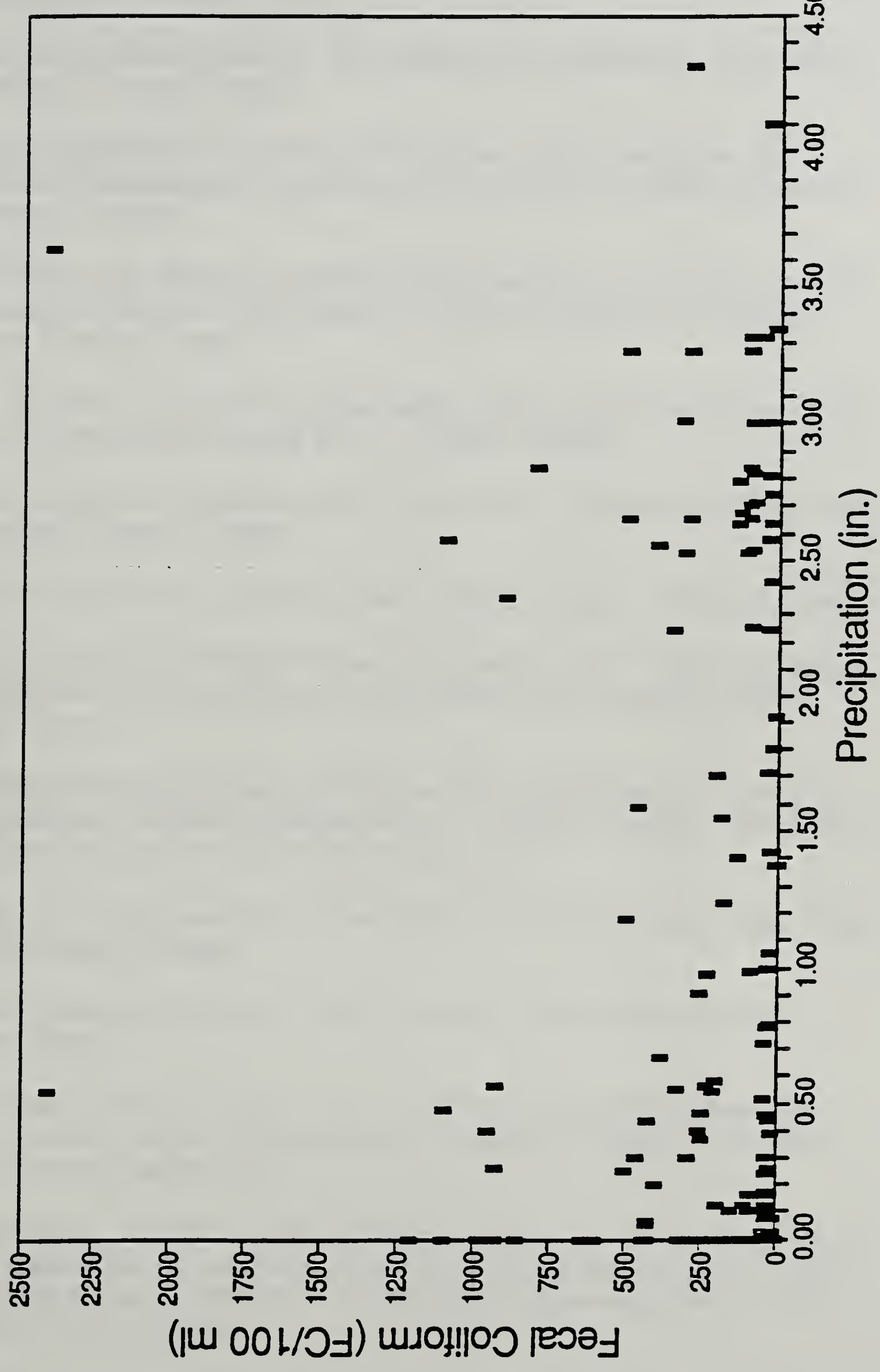
Wilson River Site W13

Fecal Coliform Count, By Date



Wilson River Site W13

Fecal Coliform vs. Precipitation



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